

SPARK

R E P O R T

STRATEGIC
PLANNING
FOR
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Science
Council of
British
Columbia



**SURVEY RESULTS
OF
THE B.C. MANUFACTURERS' NEEDS
SURVEY**

September 27, 1990

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SPARK MANUFACTURING SECTOR

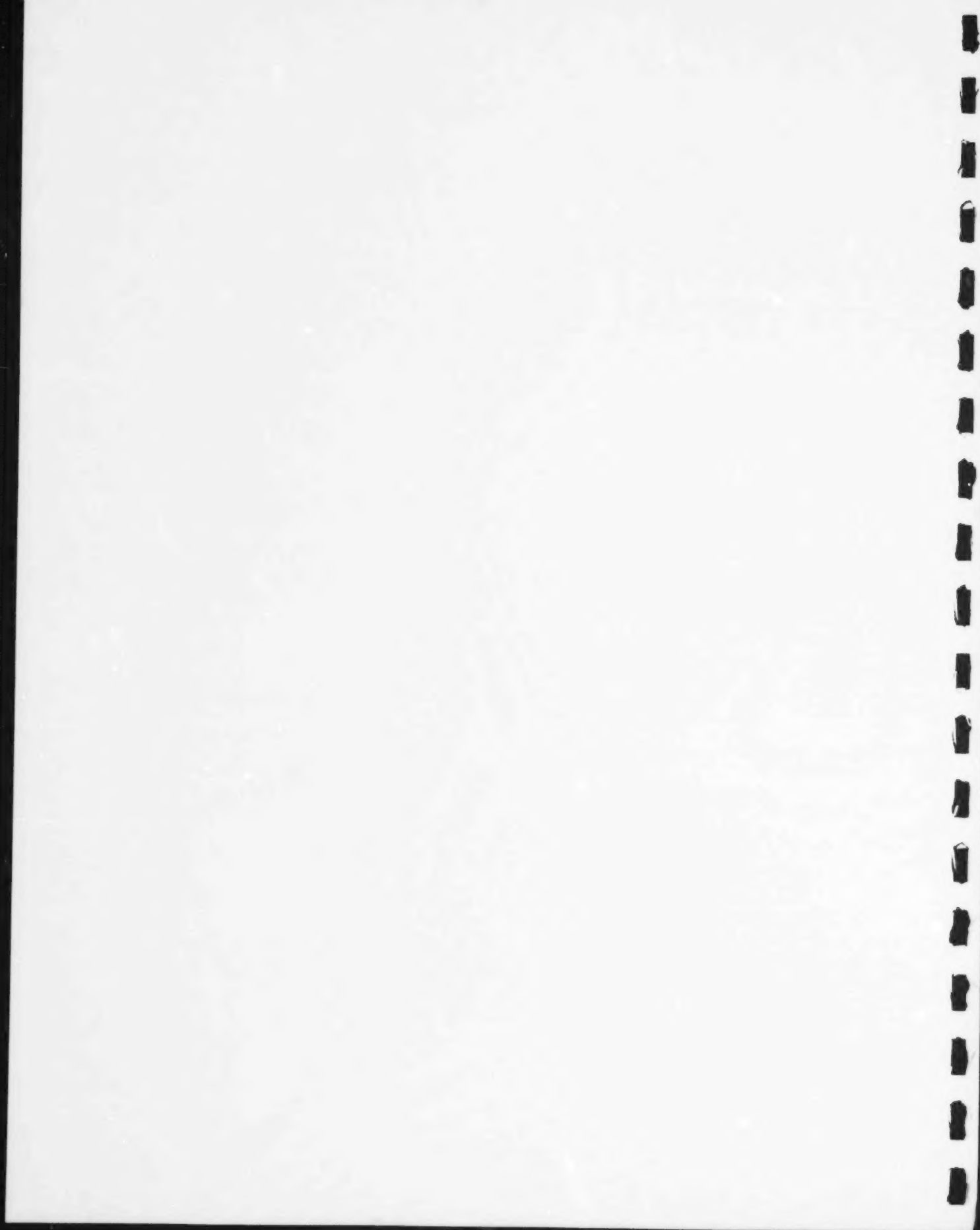


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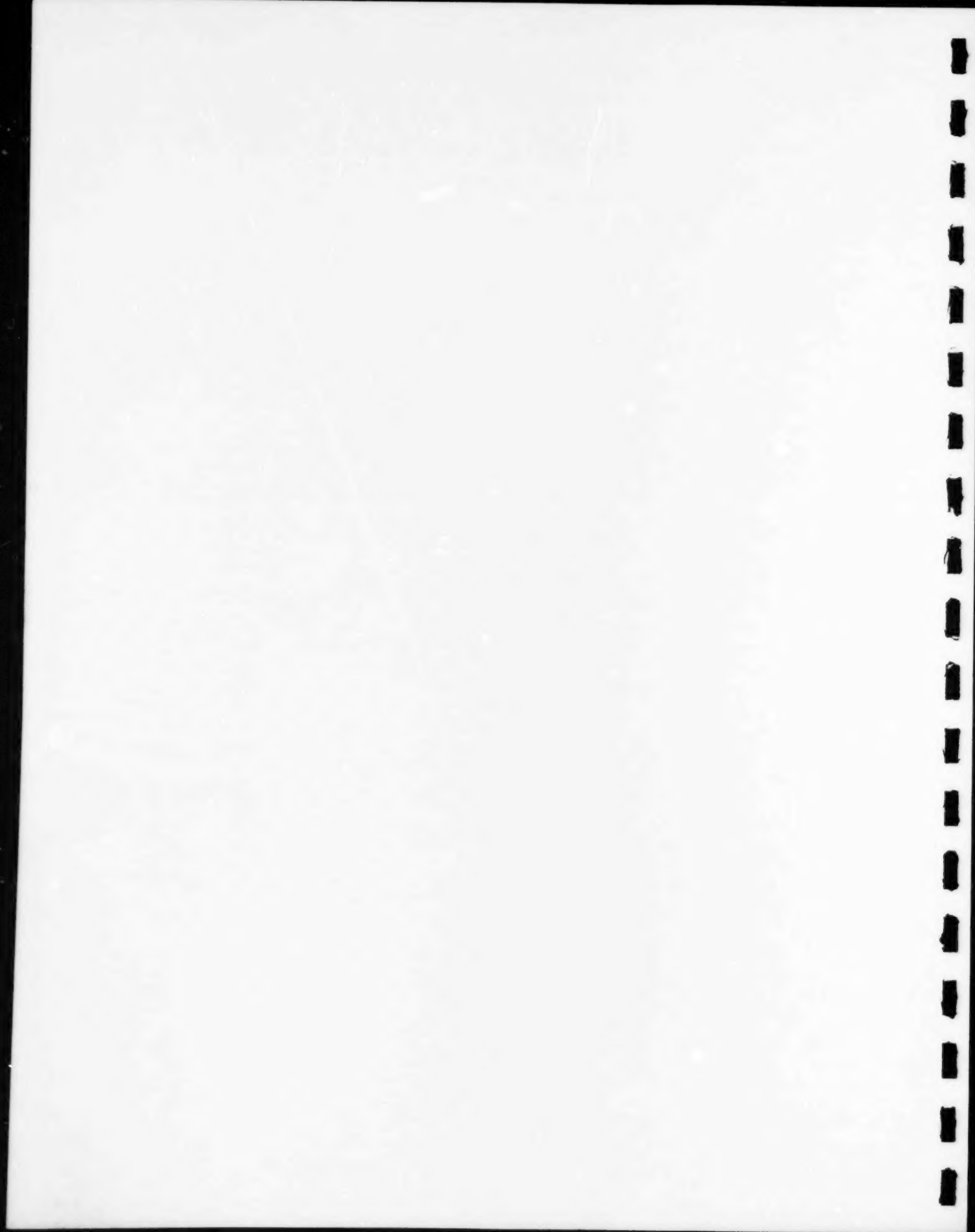
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We would like to gratefully acknowledge the help of 360 unnamed B.C. manufacturing companies who participated in this survey.



1.0 Introduction

The challenges and opportunities confronting B.C. manufacturers in the 1990s are both numerous and far-reaching. As our economy shifts from being primarily resource based to a service and secondary manufacturing economy, more and more manufacturing companies will play an active role in deciding B.C.'s economic future. To get a clearer image of this future, the Science Council of B.C. recognised that an up-to-date profile of this industry was in order. The B.C. Manufacturers' Needs Survey was created to gain a better understanding of the changing needs and expectations of this growing industry. Three objectives of the survey were identified:

- to identify key strengths and weaknesses in the manufacturing industry in order to zero in on areas which require immediate attention;
- to obtain a comprehensive and up-to-date needs assessment of B.C. manufacturing companies; and
- to help develop an aggressive support strategy which will address these needs.

2.0 Survey Methodology

A total of 303 manufacturing companies responded to the B.C. Manufacturers' Needs Survey. Eighty percent of the respondents operate their business in the Lower Mainland. Approximately 3,000 manufacturing companies received the survey and the results represent the views of 12% of this audience. This sample size appears small, but statistically it is acceptable. In general, sampling error is most affected by the absolute size of the sample rather than the ratio of the sample size to the population size. For statistical significance the minimum number of cases is thirty. Of course, the larger the sample, the less chance of error. In terms of value of sales, however, our sample size represents 34% of the B.C. manufacturing population, and for the number of employees, the sample size represented 21.4% of the population.

Regardless of this, one must, of course, be cautioned when interpreting the data. In any survey, there exists a number of factors which may bias the results. This survey, in particular, called for a great deal of objective self-assessment on the part of the respondent. We expected some degree of positive self-presentation in this survey and not surprisingly, the manufacturers sampled in the survey appeared to be very optimistic when reporting their results. Whether there is some basis to this optimism or it is their nature to be optimistic, we are not sure. We leave it up to the reader to decide.

In addition, two incomplete surveys were received by companies planning to

close their business due to poor sales. It is more than likely that a number of manufacturers decided not to participate in the survey for the same reason.

Since the survey could not measure this segment of the population, the results will tend to appear more positive than it should be. Over the last three years, 7% or less of the B.C. manufacturing sector have applied for grants from the Science Council of B.C. We identified 17% of survey respondents as Science Council of B.C. grant applicants or committee members. This number seems to represent a disproportionately high response rate from companies actively involved in research and development. Therefore, survey estimates for the amount of research and development spending/work performed by B.C. manufacturers may be positively biased.

Finally, we recognise that there were a number of manufacturers who could not participate in the survey because they were too busy. These respondents were likely to represent manufacturers who are doing quite well due to the high level of business their company is experiencing. Again, this may also bias the results.

The survey sample was selected from the SPARK Manufacturing Database which contains up-to-date records of 3,236 B.C. manufacturing companies. The survey was mailed out in May 1990. Prior to this, a telephone call was made to each manufacturer to obtain permission from them to send the survey to their establishment.

Quantitative data were tabulated using the Microsoft Excel and Statview Software programs. Responses from qualitative questions were aggregated borrowing words and phrases most often used by survey respondents.

3.0 Summary of Findings

3.1 Highlights

- Almost one out of four respondents rate themselves at the leading edge of technology. Thirty-six percent of companies rate themselves at an advanced technology level, and 42% of companies are at the traditional technology level.
- The four leading industries rated at the leading edge of technology were the aerospace, medical devices, marine & oceanic, and electronics industries.
- Companies who perceive themselves at the leading edge of production and technology were the largest users of manufacturing technologies surveyed.

- About two-thirds of companies surveyed favour the establishment of a manufacturing technology training and research centre. Respondents cited the need for more training, technical consulting, and demonstration of new technologies as the main reasons why they would support the centre.
- One quarter of respondents did not support the centre. This group indicated that the proposed centre would probably not be specialized enough for their needs.
- The most popular funding mix for the centre was fifty-fifty support by government and industry.
- Overall, more than 50% of manufacturers find their training needs aren't adequately met.
- The greatest constraint facing manufacturers with regards to hiring and training of their workers is the high cost of formal training. One third of manufacturers felt that job training was too costly last year.
- The demand for apprentices, journeymen, and technologists ranked the highest by respondents. Based on the demand by survey respondents, a projected demand of over 6,000 apprentices, 4,600 journeymen, and 3,200 technologists is required by the entire manufacturing industry in B.C.
- Personnel demand data reveal that the computer software industry expect to experience the greatest growth of over 25% annually over the next 5 years. Much of this demand is for computer programmers, management personnel, marketing personnel, and people skilled in expert systems and CADD.
- One half of survey respondents spend between 0.1-5.0% of sales on R & D, 18% of respondents spend between 5.0-25%, and 15% of respondents spend over 25% of their sales on R & D.
- Thirty-one percent of manufacturers plan to increase their R & D spending, 63% of manufacturers intend to spend the same amount as the previous year, and 6% of manufacturers plan to decrease their R & D spending for 1990.
- In general, one out of every three manufacturers do their R & D work in-house.

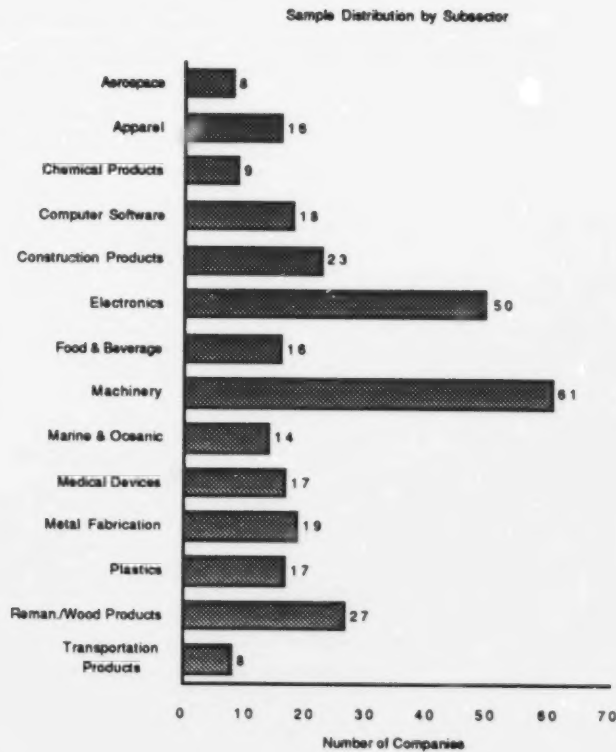
- The number one constraint facing manufacturers with regards to furthering more R & D work is the lack of money.
- The electronics industry anticipates the highest sales growth with an expected annual growth rate of 28.5%. Other leading industries include oceanic & marine with 23.7% expected growth, and aerospace with 22.7% anticipated growth.
- One out of two manufacturers cited the lack of capital as the primary cause of slow growth in their company.
- Many B.C. manufacturers are planning to increase their level of exports in the future. Twenty-nine per cent of manufacturers see the opening up of new markets as a major opportunity.

4.0 Company Profile

4.1 Distribution by Subsector

- The companies surveyed were divided into 14 subsectors ranging from primary to secondary industries.
- The largest group represented is the machinery industry with 20% of manufacturers surveyed, followed by the electronics industry with 17% of manufacturers.
- Manufacturers from the biotechnology, printing, sawmilling, pulp and paper, fish, aquaculture, and veneer/plywood industries were excluded due to the low level of representation. In addition, consulting and research & development firms were also not included in the survey analysis.

Chart 4.2



4.3 Distribution by Size

- The majority of establishments surveyed are small-size firms with less than 24 employees.
- Sixty-two percent of companies surveyed employed 24 people or less, while 38% of companies have more than 24 employees.

Chart 4.4

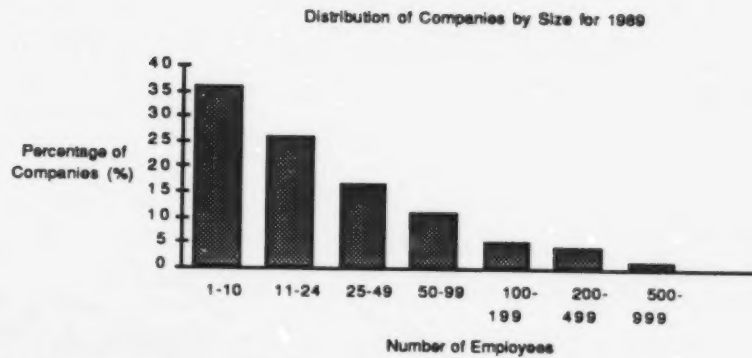
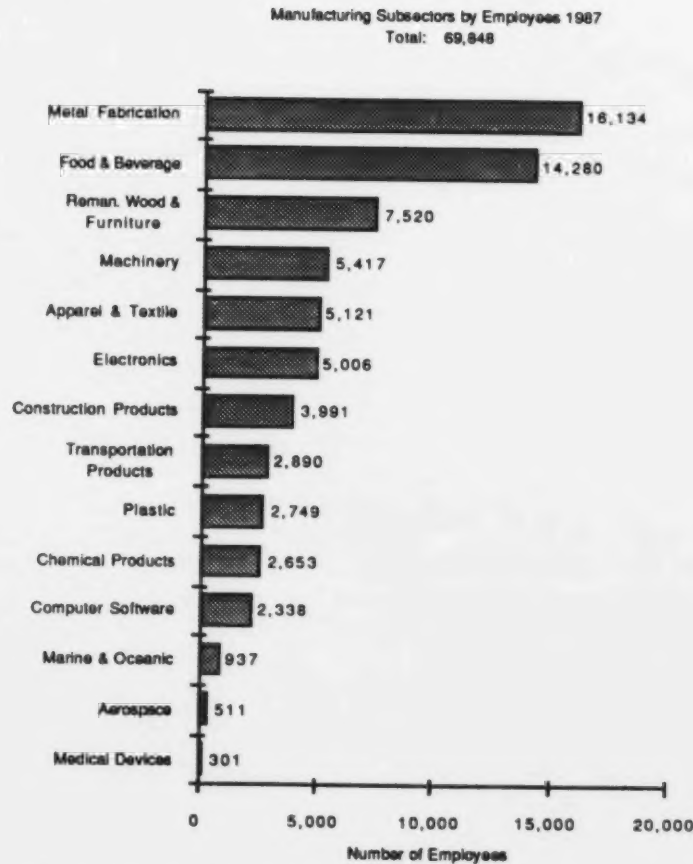


Chart 4.5

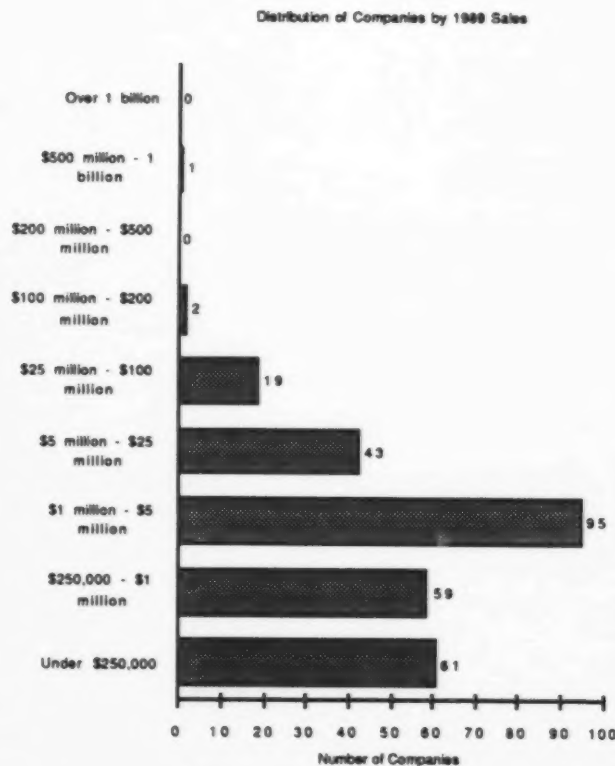


Source: Statistics Canada, Manufacturing Industries of Canada 1987, 81-203

4.6 Distribution by Sales

- Fifty-seven percent of companies surveyed reported sales over 1 million for 1989.
- There are very few large firms represented in the survey. Less than 1% of companies surveyed had sales in excess of 100 million.

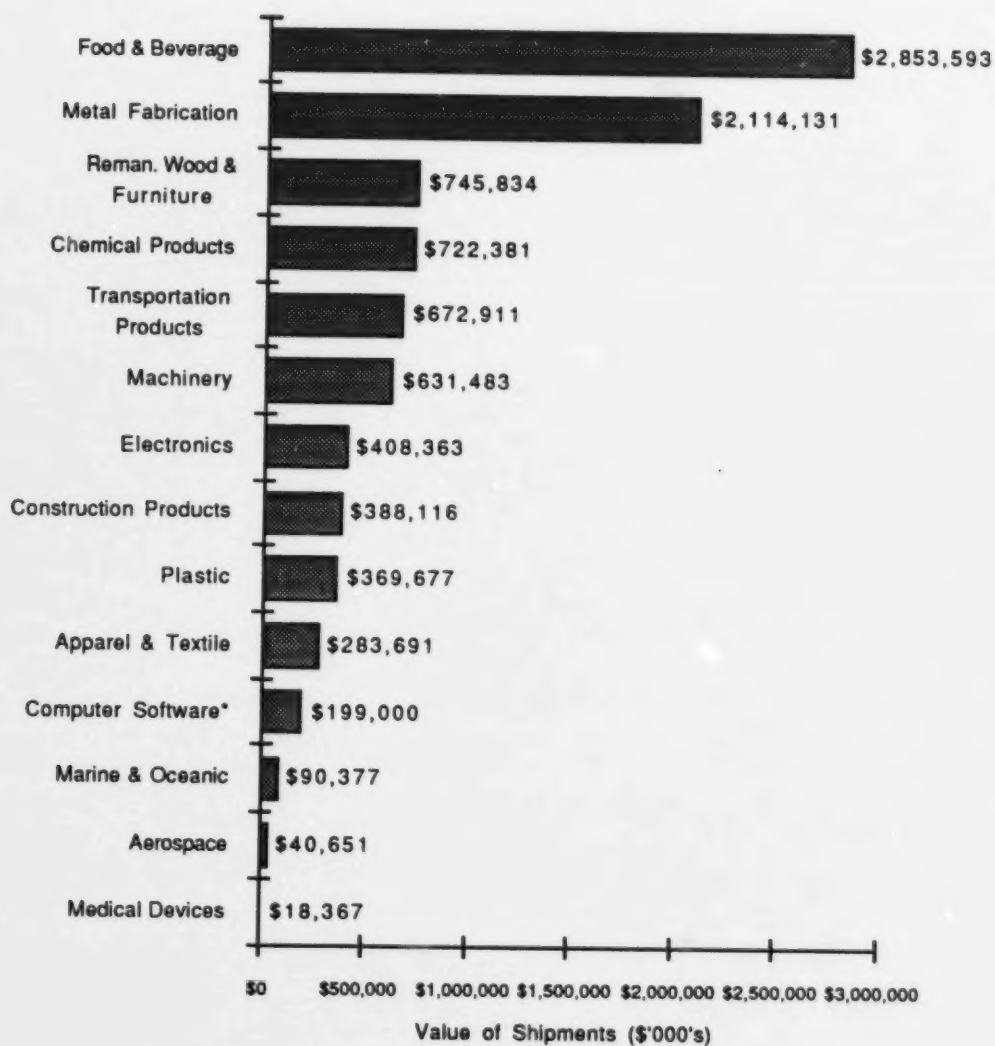
Chart 4.7



- According to the most recent figures from Statistics Canada the metal fabrication and food & beverage and industries in B.C. recorded the highest value of shipment sales in excess of two billion for 1987. Emerging industries such as marine & oceanic, aerospace, and medical devices manufacturers reported the lowest figures with sales under 100 million.

Chart 4.8

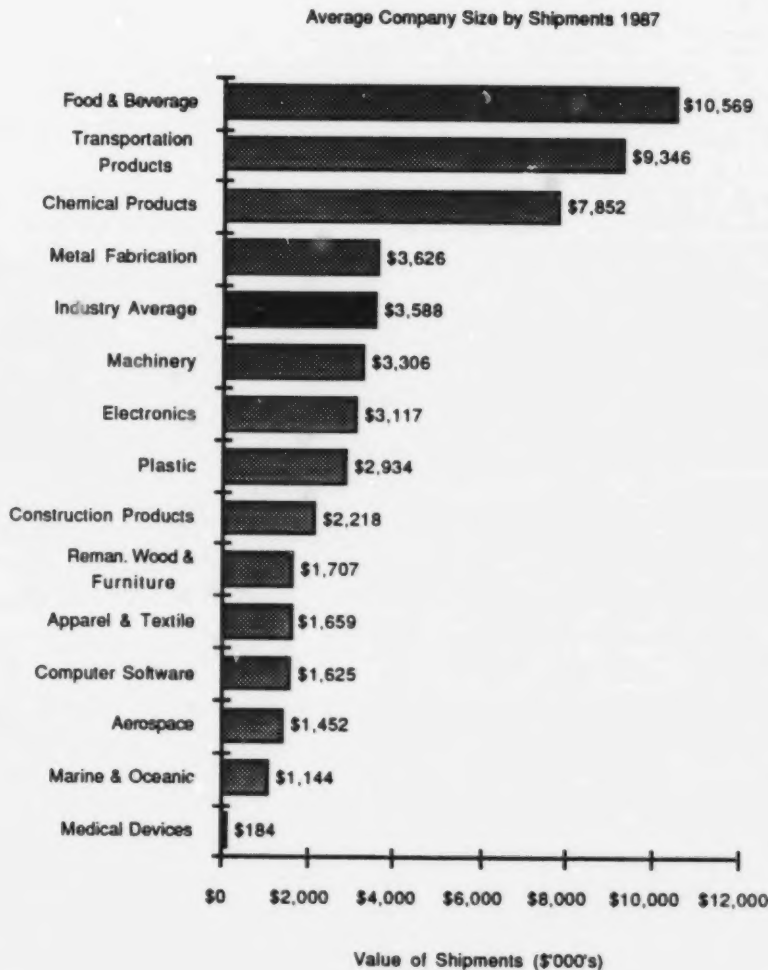
Manufacturing Subsectors by Shipments 1987
Total \$9.34 billion



Source: Statistics Canada, Manufacturing Industries of Canada 1987, 81-203

* B.C. Technology Directory 1990

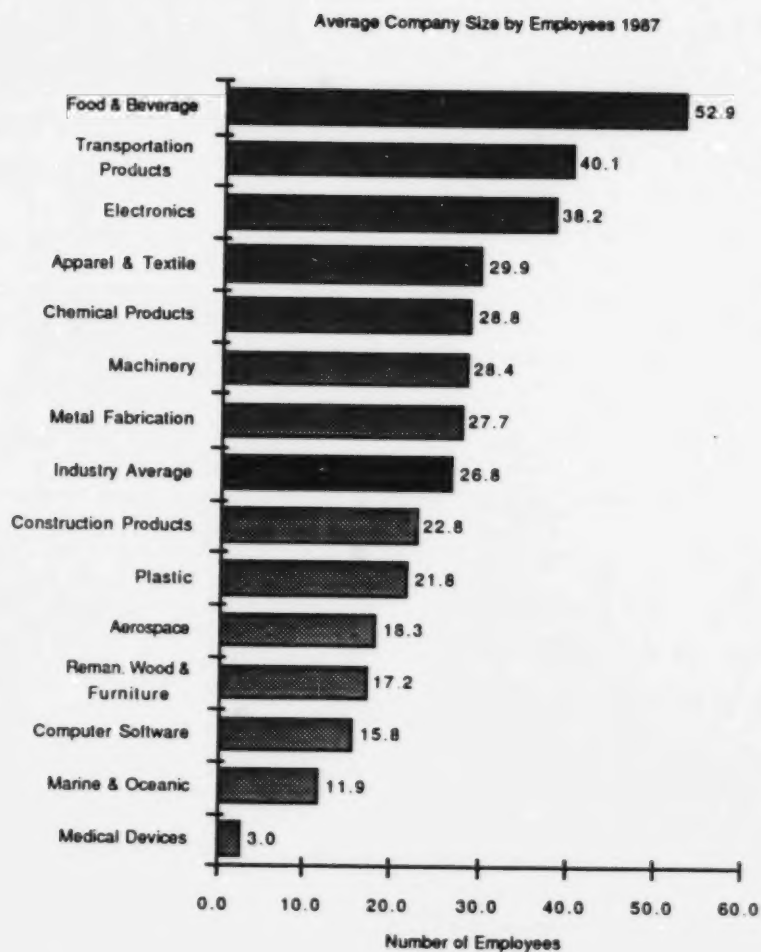
Chart 4.9



Source: Statistics Canada, Manufacturing Industries of Canada 1987, 81-203

- The average company size of B.C. manufacturing companies in 1987 was about 27 employees according to Statistics Canada. Small-size firms such as medical device manufacturers had an average of 3 employees while more labour intensive manufacturers such as the food & beverage industry employed about 53 employees in 1987.

Chart 4.10



Source: Statistics Canada, Manufacturing Industries of Canada 1987, 81-203

5.0 Technology Use

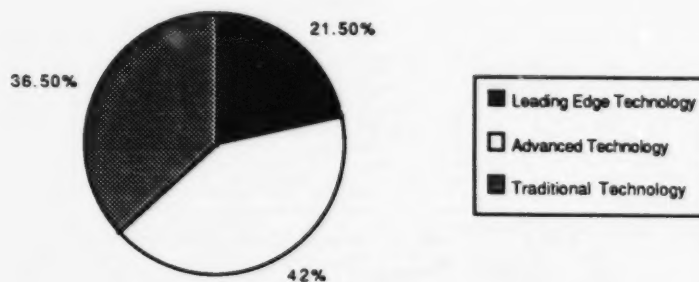
5.1 Perceived Technology Level

- Manufacturers were asked to rate their level of production and related technology using three terms: leading edge technology, advanced technology, and traditional technology. Leading edge technology refers to companies who consider themselves occupying an international leadership position in technology. Companies who perceive themselves at par with

their competitors are defined as advanced technology users. Traditional technology users encompass companies who consider themselves producing at the traditional technology level. Further attempts to define these terms were not made because we wanted the manufacturers' perception of where they stood based on their own interpretation of these terms rather than our interpretation of their responses.

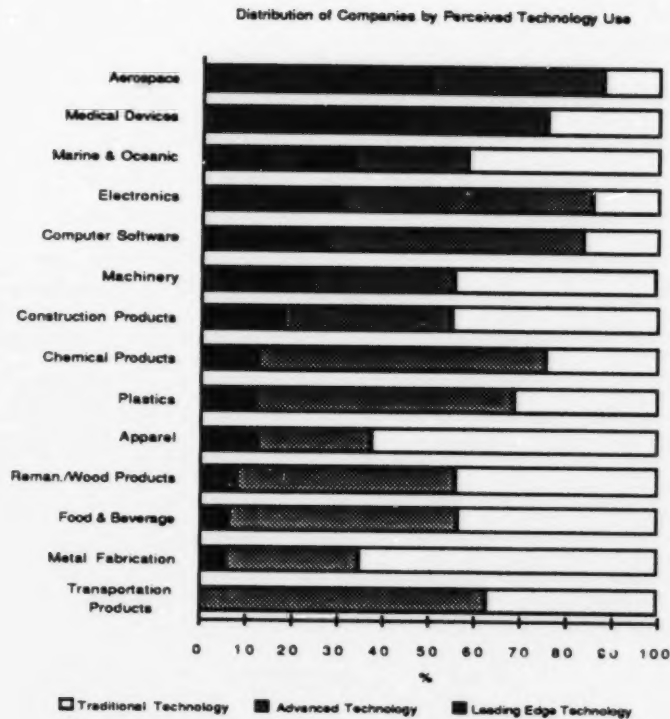
Chart 5.2

Distribution of Companies Surveyed at Different Perceived Technology Levels



- Almost one out of four manufacturers rated their production and level of technology at the leading edge of technology. Thirty-six percent of companies perceived themselves at an advanced technology level, and 42% of companies consider themselves at the traditional technology level.
- The largest group rated at the leading edge of technology was the aerospace industry, followed closely by the medical devices, marine & oceanic, and electronics industries. Companies who rated themselves at the advanced technology level were represented by the chemical and transportation products industries. Primary industries such as metal fabrication and remanufactured/wood products largely represented the traditional technology level group.

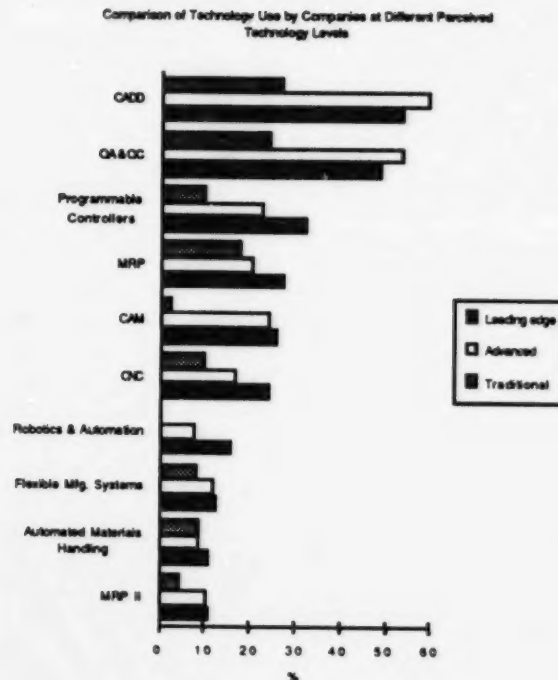
Chart 5.3



5.4 Comparison of Perceived Technology Level and Technology Use

- As expected, companies who perceived themselves at the leading edge of production and technology were the largest users of the technologies surveyed. However, when compared to the use of technology by advanced technology companies, the difference between the two groups were negligible, and in the cases of CADD and QA/QC use, advanced technology companies were heavier users of these technologies than leading edge technology companies. Technology use by manufacturers who rated themselves at the traditional level of production and technology were, not surprisingly, the lowest of the three groups.
- The survey also reveals that more than 50% of leading edge technology manufacturers use CADD while 16% of the same group use robotics and automation in their production process. The low level use of robotics and automation seems to suggest that it is still a novelty among manufacturers as compared to CADD, which is used widely.

Chart 5.5



5.6 Use of Advanced Technology

- Manufacturers were asked to list any advanced technologies used in the company's production process. The question was designed to be open-ended in order to allow manufacturers to list other technologies which they considered to be advanced, but were not named in question #4 of the survey. The three most common technologies used by companies were CNC or computer related technologies, CAD, and CAM. With the exception of QA/QC, this result was consistent with the following question, which revealed QA/QC, CAM, and CADD as leading technologies used by manufacturers. One explanation for the poor response for QA/QC is that manufacturers may not consider QA/QC as an advanced technology.
- About 10% of manufacturers claimed that they did not use any advanced technologies in their company's production process. However, it was found that almost half of this group did indeed use one of the advanced technologies listed in question #4. A few possible explanations may account for this inconsistency. First, some respondents may have failed to read the question properly. However, it seems more likely that some

respondents clearly do not consider themselves as advanced technology users or are not aware that they are operating at an advanced technology level even though the evidence points to the contrary. Another reason may be that these manufacturers do not consider the technologies listed in the survey as advanced.

Table 5.7

What advanced technologies are used in the company's production process?

TOP RESPONSES	RESPONDENTS		
	#	%	Ques.#4
CNC, computer related	49	16.2%	51
CAD	32	10.6%	137
None	31*	10.2%	---
CAM	16	5.3%	50
Robotics & Automation	13	4.3%	20
Electronics	6	2.0%	---
Environmental control	3	1.0%	---
Laser	3	1.0%	---
Microprocessors	3	1.0%	---
MRP I & II	3	1.0%	86
Other	40	13.2%	---
No response	104	34.3%	---

* In the following question (#4), 13 of the 31 companies used at least one of the technologies listed.

5.8 Current and Planned Technology Use

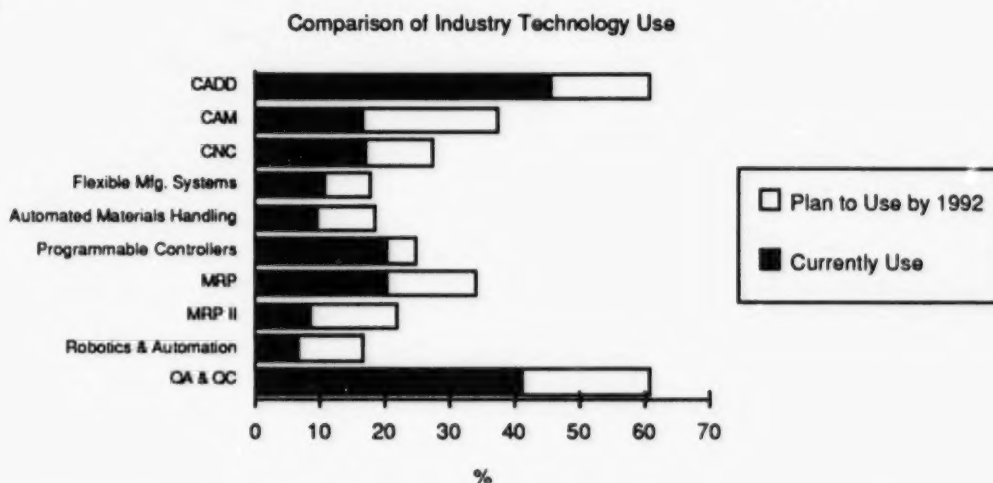
- By 1992, planned use of MRP II, robotics & automation, and CAM will double in size from the current use of these technologies. An increase from 10-22% of manufacturers surveyed expect to use these technologies in their production process in the future.

5.9 Technology Use - Subsectors

- The aerospace and electronics industries report the largest percentage of companies using the advanced technologies such as CADD and QA/QC. At least 75% of aerospace companies surveyed employ CADD, CNC, and QA/QC. Three quarters of the electronic industry also use CADD, and at least 50% of these companies use QA/QC.

- The marine, metal, and transportation industries employ the fewest number of advanced technologies listed in the survey. None of these industries use or plan to use robotics and automation, and very few of them use programmable controllers and MRP II.
- When considering these results, however, one must keep in mind that technology use differs from industry to industry because of differences in the application and relevancy of the technology in the industry.

Chart 5.10



* Please refer to glossary of abbreviations.

Chart 5.11

Technology Use in the Aerospace Industry

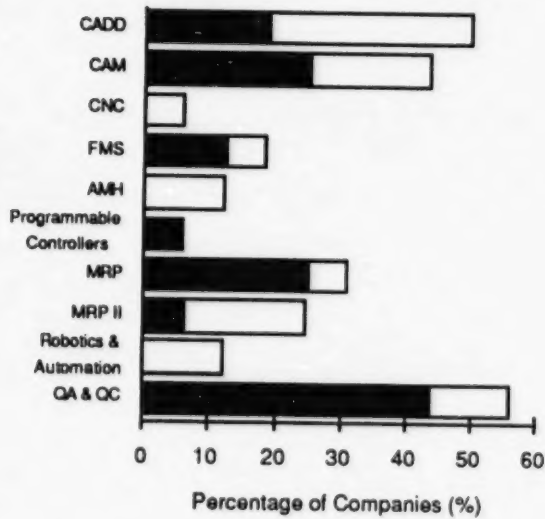


Chart 5.12

Technology Use in the Apparel Industry

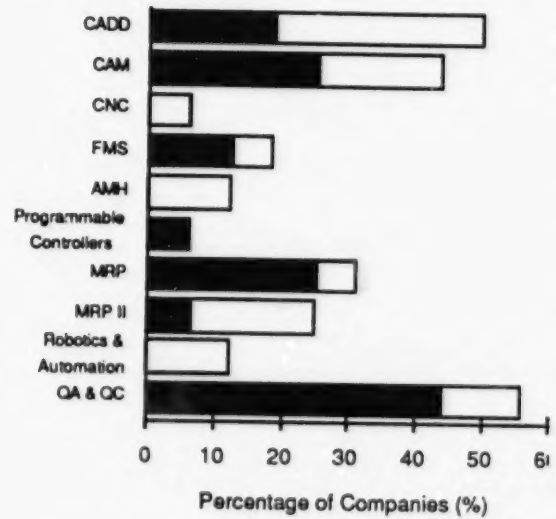


Chart 5.13

Technology Use in the Chemical Products Industry

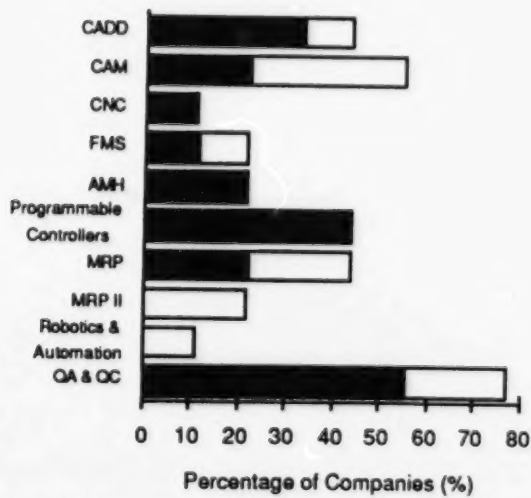
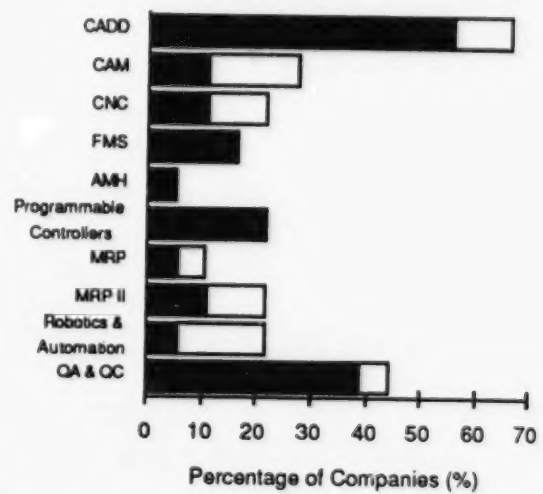


Chart 5.14

Technology Use in the Computer Software Industry



■ Currently Use □ Plan to Use by 1992

Chart 5.15

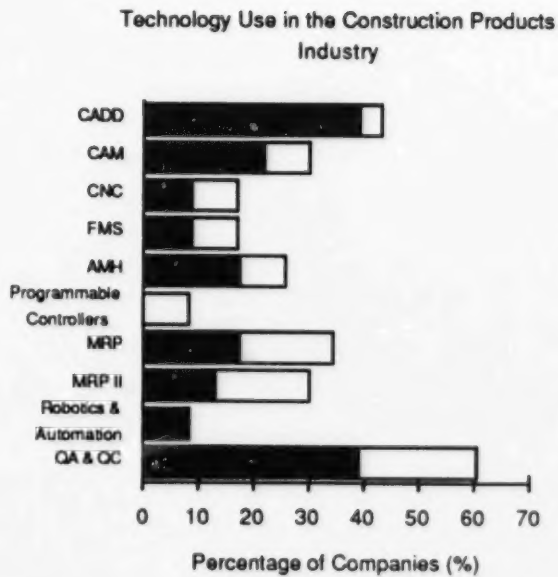


Chart 5.16

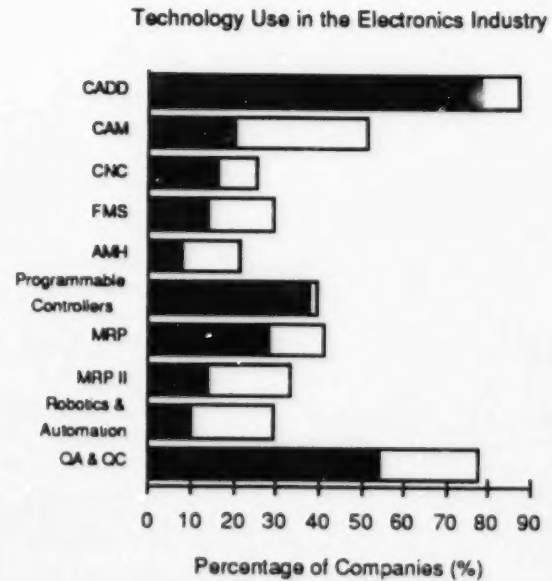


Chart 5.17

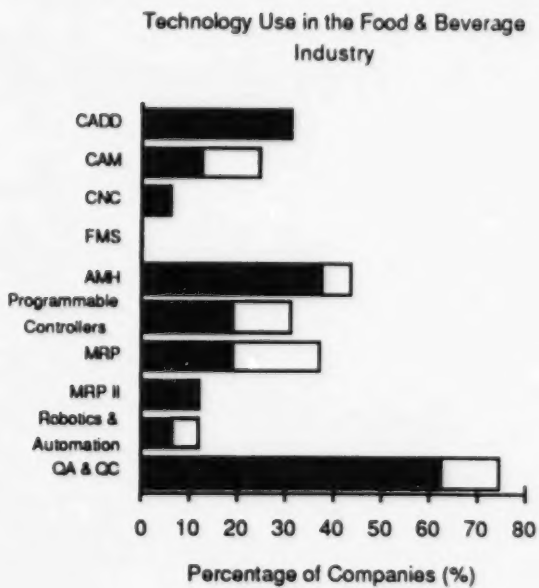
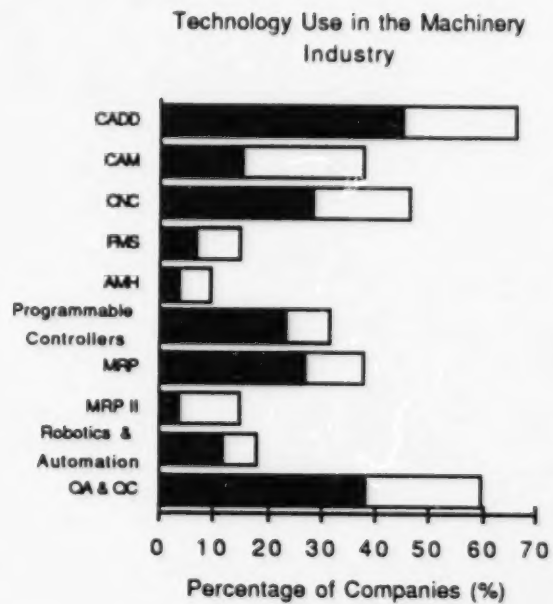


Chart 5.18



■ Currently Use

□ Plan to Use by 1992

Chart 5.19

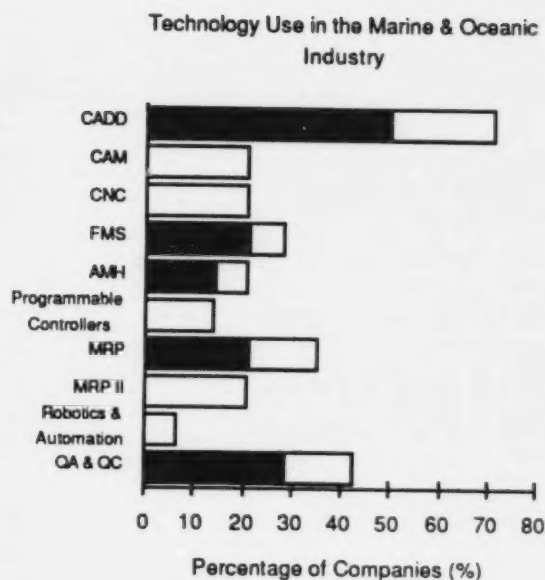


Chart 5.20

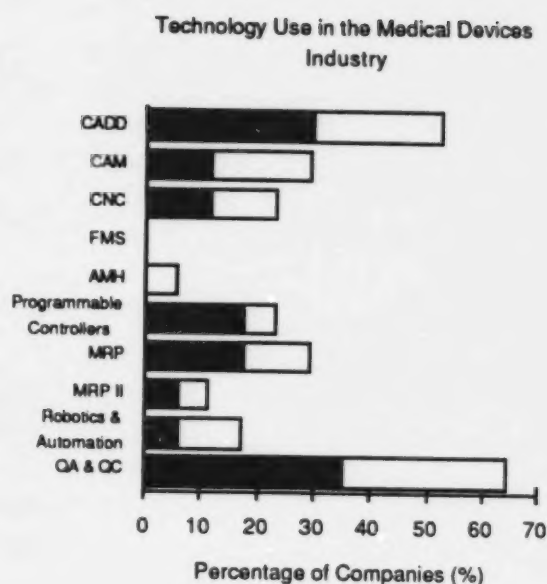


Chart 5.21

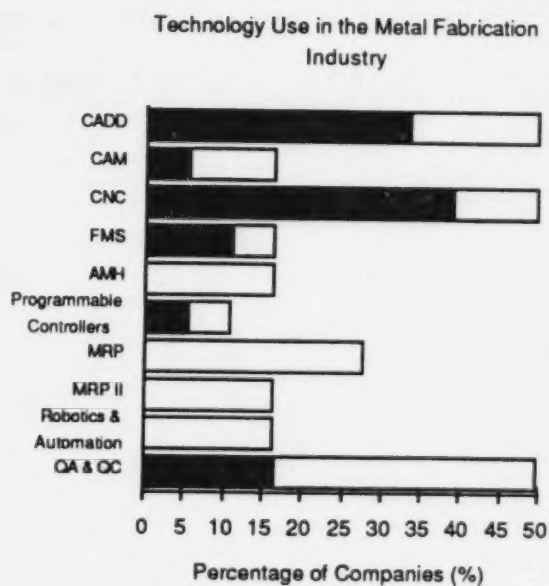
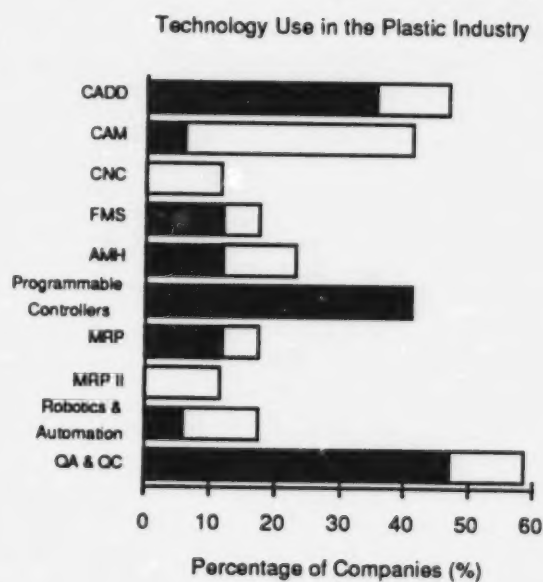


Chart 5.22



■ Currently Use □ Plan to Use by 1992

Chart 5.23

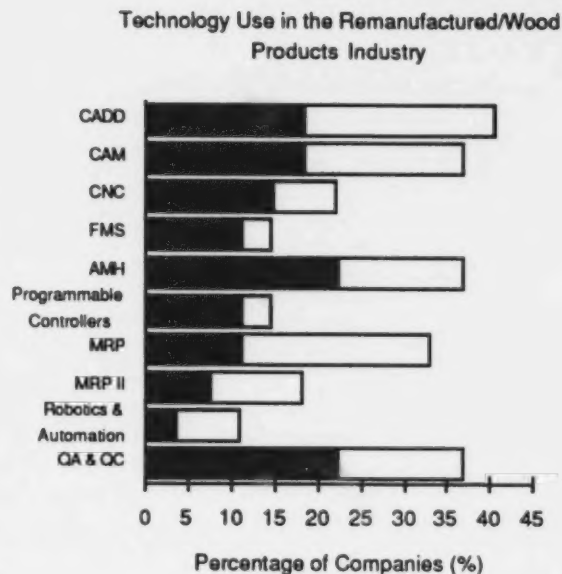
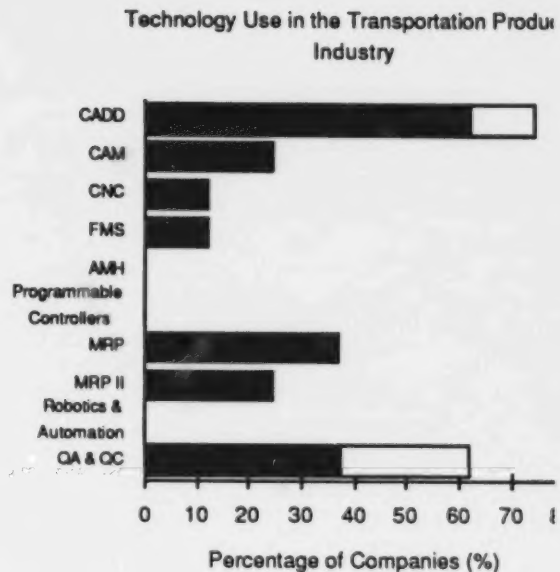


Chart 5.24



6.0 Proposed Manufacturing Technology Training and Research Centre

6.1 Distribution of Companies For/Against the Centre

- About two-thirds of companies surveyed favour the establishment of a manufacturing technology training and research centre. Respondents cited the need for more training, technical consulting, and demonstration of new technologies as the main reasons why they would support the centre.
- One quarter of respondents did not support the centre. This group indicated that the proposed centre would probably not be specialized enough for their needs and that the need for such a centre would not justify the costs.
- With the exception of the food & beverage industry, at least 50% of manufacturers support the centre, and in particular, over 80% of manufacturers from the construction products, apparel, marine & oceanic, electronics, and metal fabrication industries would like to see the centre built. Only 40% of food & beverage manufacturers, many of whom feel they already have the infrastructure in place in the form of the Food Technology Centre at B.C. Research, see the need for such a centre.

Chart 6.2

Percentage Distribution of Companies For/Against the Proposed Manufacturing Technology Training and Research Centre



Chart 6.3

Percentage Distribution by Subsector For/Against the Proposed Manufacturing Technology Training and Research Centre

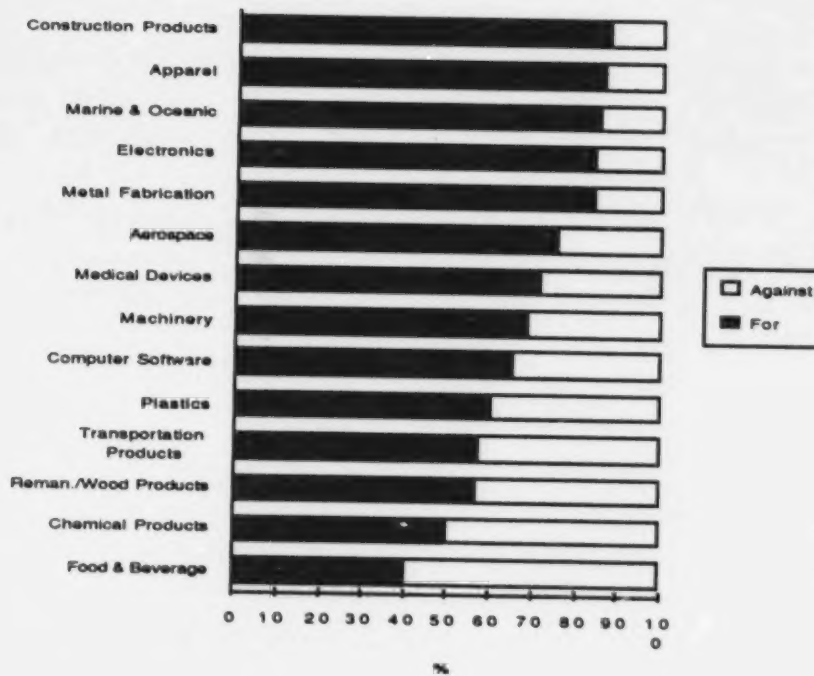


Table 6.4

If a manufacturing technology training and research centre were established in B.C, would you use such a centre?

Please explain your answer:

"Yes" respondents:

TOP RESPONSES	RESPONDENTS	
	#	%
Training	46	15.2%
Technical consulting	32	10.6%
Demonstration of new technology	27	8.9%
Applied R & D, testing	21	6.9%
Information	17	5.6%
If applicable to my needs	14	4.6%
Networking	8	2.6%
Depends on cost	7	2.3%
Updating	6	2.0%
Consolidated source exclusive to manufacturing	4	1.3%
If outside the Lower Mainland	4	1.3%
Would complement other sources	4	1.3%

"No" Respondents:

Wouldn't be specialized enough for our needs	21	6.9%
No need	10	3.3%
R & D done elsewhere	6	2.0%
Too costly	4	1.3%
Services already exist elsewhere	3	1.0%
The centre would compete with our services	3	1.0%
Not sure	18	5.6%

6.5 Proposed Facilities and Services Favoured by Survey Respondents

- Many manufacturers lack the resources to test their ideas and to develop their concepts to the production stage. This demand is reflected by the need for facilities such as new technology demonstration, applied R & D and testing facilities.
- One out of three manufacturers see the need for more testing, applied R & D, and new technology demonstration facilities.
- Technology transfer in terms of available information is also a concern of manufacturers. Over one out of three manufacturers would like to see

technical consulting and information services and outreach programs offered by the centre. Many manufacturers want information on new technologies, computers, MRP II, surface mount technology, plastics, and how to access R & D funding money.

Table 6.6

What facilities and services would you like to see offered?

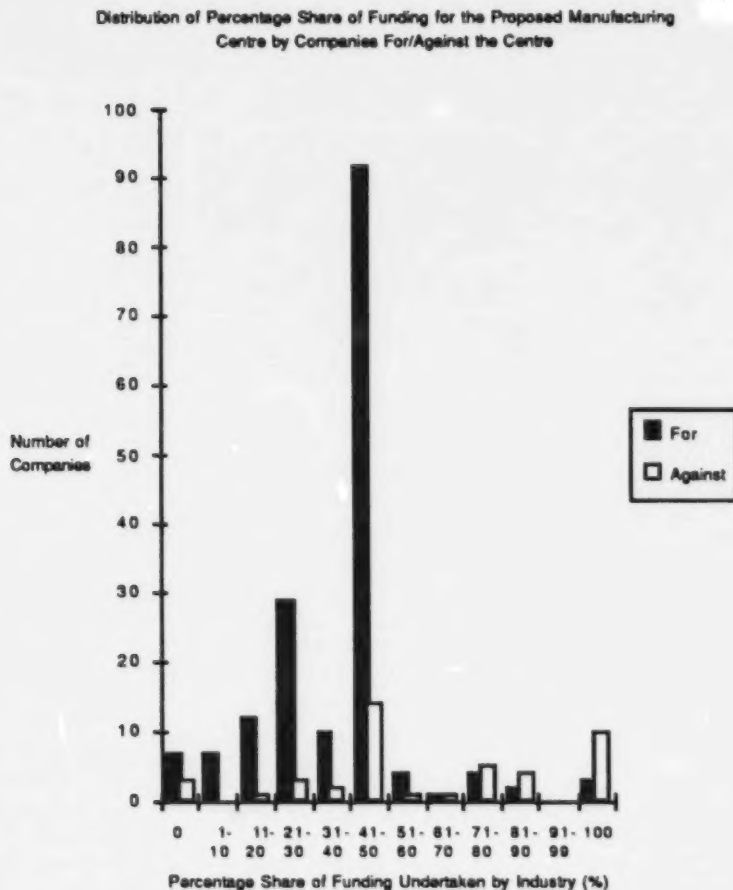
TOP RESPONSES	RESPONDENTS	
	#	%
Technical consulting	38	12.5%
Training	35	11.6%
Applied R & D/Testing facility	29	9.6%
Demonstration of new technology	19	6.3%
Information services	21	6.9%
Outreach program	18	5.9%
CAD/CAM testing facilities	10	3.3%
QA/QC testing facilities	9	3.0%
Technology library	9	3.0%
Market information	8	2.6%
Robotics & automation testing facilities	8	2.6%
Plastics information	6	2.0%
R & D funding information	6	2.0%
Financial advice	6	2.0%
Other:	22	7.3%
Business administration information		
Computer related information		
Engineering assistance		
Employment board		
Intellectual property research information		
Information of improving efficiency		
Meeting areas		
MRP I & II information		
Surface mount technology information		

6.7 Funding Allocation Favoured by Survey Respondents

- Almost one third of manufacturers favour equal funding of the centre by government and industry. The majority of manufacturers in favour of the centre lean toward a heavier funding burden undertaken by the government.
- The remaining one quarter of manufacturers who did not support the centre also favoured equal funding of the centre by government and

industry. This group tended to lean toward a heavier funding burden undertaken by industry.

Chart 6.8



7.0 Manufacturing Technology Information

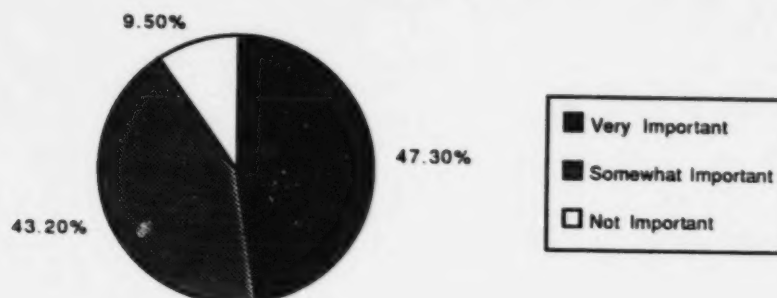
7.1 Importance of Manufacturing Technology Information

- Knowledge plays an integral role in the development of progressive technology. Information on new technology, new production methods, and how they can be sourced is vital to whether manufacturers lead or follow in the marketplace.

- More than 90% of respondents feel that it is important to find out information on advanced manufacturing technology. Less than 10% of manufacturers felt it was not important.

Chart 7.2

Industry Response to the question, "How important is it to you to find out information on advanced manufacturing technology?"



7.3 Sources of Manufacturing Technology Information

- Most manufacturers sought trade publications, suppliers/vendors, and trade shows for information on advanced manufacturing technology.
- One out of four manufacturers seek manufacturing technology information from sources outside the province. These manufacturers found answers from trade shows, suppliers, other manufacturers, consultants, universities/colleges, and trade associations. Many manufacturers indicated that the information services offered in B.C. are inadequate for their needs.

Table 7.4

Where do you seek information on advanced manufacturing technology?

TOP RESPONSES	RESPONDENTS	
	#	%
Trade publications	212	70.0%
Machinery supplier/vendor	187	61.7%
Trade shows	185	61.1%
Other manufacturers	123	40.6%
Universities/colleges	64	21.2%
Information workshops	56	18.5%
Government agencies	33	10.9%
Do not seek information	16	5.0%
Outside B.C. (total):		
U.S.	16	5.3%
Europe	12	4.0%
Trade shows	11	3.6%
Machinery supplier/vendor	9	3.0%
Other manufacturers	8	2.6%
Trade associations	6	2.0%
Rest of Canada	5	1.7%
Japan	5	1.7%
Consultants	2	1.0%
National Research Council	2	1.0%
Other:		
Consultants	6	2.0%
Library	3	1.0%
Parent Company	4	1.3%
Customers	2	1.0%

7.5 What Information is being sought

- Some 23% of manufacturers seek information on new equipment/technology, improvements in manufacturing, efficiency, automation, cost/benefit of new machinery and technology, and other product specific data.
- A small proportion of manufacturers also seek information on the use of CADD/CAM, QA/QC, JIT, laser technology, MRP and MRP II, and surface mount technology.
- The type of information sought reveals that manufacturers are actively adopting value-added measures in an effort to improve their level of production.

Table 7.6

If you do seek information on advanced manufacturing technology, what specific information are you seeking?

TOP RESPONSES	RESPONDENTS	
	#	%
New equipment/technology	24	7.9%
Improvements in manufacturing efficiency	21	6.9%
Automation	16	5.3%
Cost/benefit information	15	5.0%
Product specific data	9	3.0%
CAD/CAM	8	2.6%
QA/QC	8	2.6%
JIT	3	1.0%
Laser technology	3	1.0%
MRP	3	1.0%
New materials	3	1.0%
Nothing	3	1.0%
Surface mount technology	3	1.0%

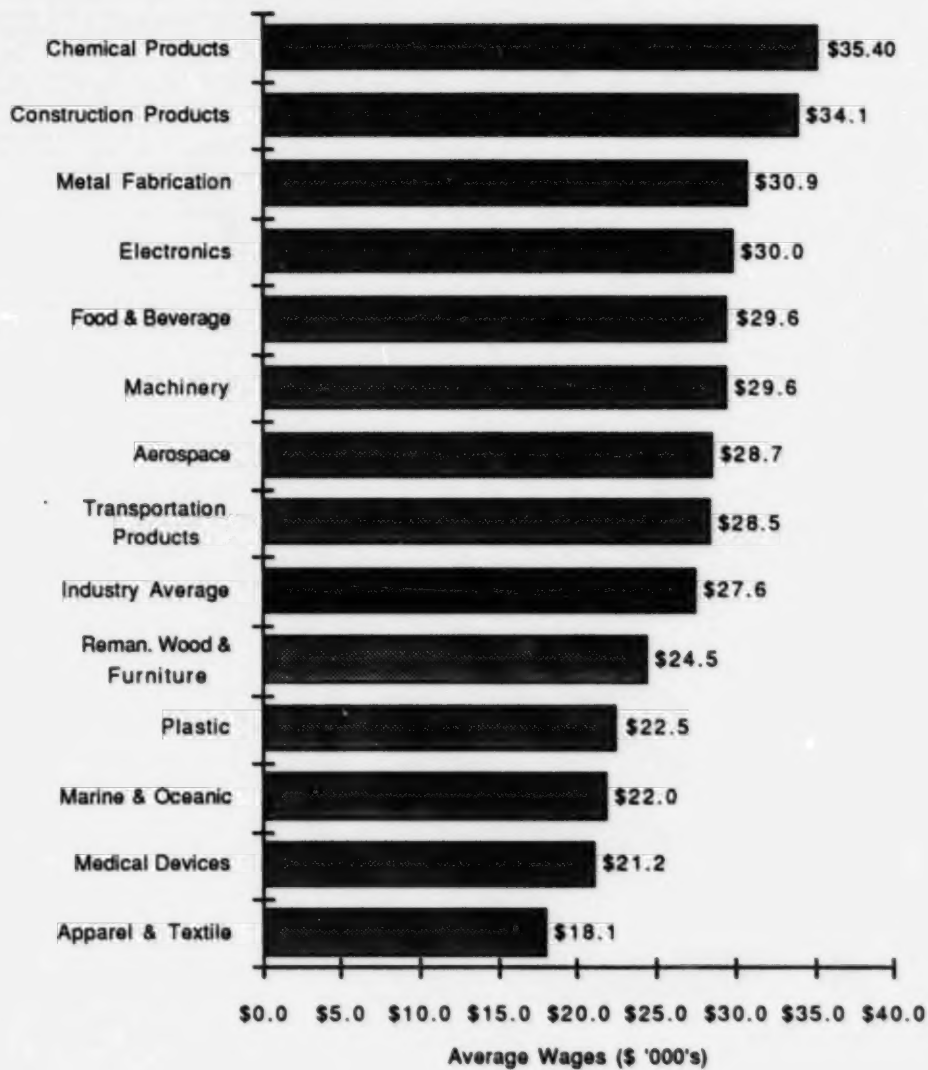
8.0 Education and Training

8.1 Statistic Canada Employee Profile

- The average wage for 1987 was \$27,600 for the B.C. manufacturing industry with employees from the chemical and construction product industries earning the highest income on average.
- Leading manufacturers in terms of 1987 shipments per employee were the chemical and transportation products industries with sales in excess of \$200,000.

Chart 8.2

Average Employee Wages 1987



Source: Statistics Canada, Manufacturing Industries of Canada 1987, 31-203

Chart 8.3



Source: Statistics Canada, Manufacturing Industries of Canada 1987, 31-203

8.4 Type of Training Skills Demanded

- The largest demand for skilled people by manufacturers were machinists, sales/marketing personnel, computer-skilled personnel, and managers. From this group about three quarters of manufacturers had difficulty in finding people with these skills.
- A substantial 72% of manufacturers encountered difficulties in recruiting skilled labour.

Table 8.5

5a. What specific training skills does your company need?

5b. Are there any difficulties in finding people with these skills?

TOP RESPONSES	RESPONDENTS			
	#	%	Yes	No
Machinists	17	5.6%	14	3
Sales/Marketing	16	5.3%	13	3
Computer skills	13	4.3%	9	4
Management skills	12	4.0%	10	2
Industrial engineers	11	3.6%	9	2
Technically skilled workers	11	3.6%	9	2
Metallurgical skills	10	3.3%	8	2
Quality assurance and control training	10	3.3%	8	2
Electronics training	9	3.0%	6	3
Production management skills	9	3.0%	7	2
CADD training	8	2.6%	6	2
Welders	8	2.6%	6	2
Textile training	8	2.6%	6	2
CNC training	7	2.3%	7	0
General manufacturing knowledge	6	2.0%	6	0
Metal fabricators	6	2.0%	6	0
CAM skills	3	1.0%	2	1
JIT skills	3	1.0%	3	0
Material handling skills	3	1.0%	3	0
MRP skills	3	1.0%	3	0
Process control training	3	1.0%	3	0
None	9	3.0%	0	9

8.6 Sources of Training Assistance

- Approximately 37% of manufacturers go to colleges/universities, suppliers, or seminars for training assistance. A little more than half this group feel their training needs have not been met.
- Fifteen percent of companies look within their organization for training assistance, and from this group fifty-six percent of them feel this is adequate for their training needs.
- Overall, more than 50% of manufacturers felt their training needs aren't adequately met.

Table 8.7

- 4a. Where do you usually go for training assistance?
4b. Does it adequately meet your training needs?

TOP RESPONSES	RESPONDENTS			
	#	%	Yes	No
Colleges/Universities	53	17.5%	19	23
In house	45	14.9%	22	17
Suppliers	35	11.6%	16	12
Seminars	25	8.3%	9	10
Other manufacturers	22	7.3%	9	7
Do not seek training assistance	20	6.6%	3	3
Government	17	5.6%	4	10
Consultants	11	3.6%	6	4
U.S.A.	11	3.6%	4	5
Industry association	9	3.0%	4	4
Trade publication	9	3.0%	3	5
Apprenticeship program	8	2.6%	4	4
B.C. Research	6	2.0%	3	2
No where available	6	2.0%	0	6
Canada Employment Centre	5	1.7%	2	3
FBDB	3	1.0%	2	0

8.8 Recruiting Difficulties

- The greatest constraint facing manufacturers with regards to hiring and training of their workers is the high cost of formal training. One third of manufacturers felt that job training was too costly last year. In addition, another 30% of companies were not able to provide formal training due to the lack of personnel and the lack of time available to train employees. Another 30% of manufacturers could not afford to release workers during working hours.
- Clearly, there is a strong need for more government financial assistance, subsidized job training programs, and training courses offered on the week-end and evenings.

Table 8.9

Which of the following constraints most affected your skills-training decision last year?

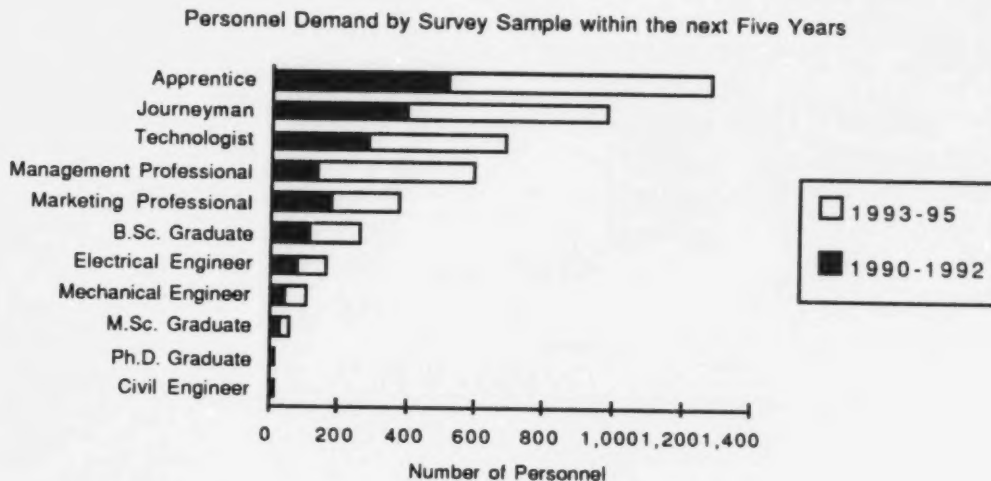
CONSTRAINTS	RESPONDENTS	
	Yes	No
High cost of formal training	101	33.3%
Cannot afford to release workers during working hours	94	31.0%
Don't have the personnel to provide formal training	93	30.1%
Don't have the time to train employees myself	91	30.0%
Don't have the facilities to provide formal training	79	26.1%
Training programs unavailable	60	19.8%
Current level of training available was inadequate	55	18.2%
Too few skilled jobs to justify formal training	40	13.2%
Risk of losing trained employees to other companies too great	30	10.0%
There are no constraints - can hire all the trained workers needed	29	9.6%
Other: No training plans	8	2.6%
Irregular work load/demand	3	1.0%

8.10 Personnel Demand over the next 5 years

- The demand for apprentices, journeymen, and technologists ranked the highest by respondents. Figures reveal that approximately 1,200 apprentices, 980 journeymen, and 680 technologists are required within the next five years by manufacturers surveyed. Overall, the data represents 21.3% of the manufacturing population in B.C. Projected for the whole industry, these figures translate to a demand of over 6,000 apprentices, 4,600 journeyman, and 3,200 technologists in the next five years.
- The demand for university educated personnel, on the other hand, is much smaller. Three hundred and three manufacturers report a demand for 267 bachelor of science graduates, 62 master of science graduates, 26 science doctorates, 22 civil engineers, 113 mechanical engineers, and 168 electrical engineers. This demand projected for the entire manufacturing industry represents over 1,200 bachelor of science graduates, 290 master of science graduates, 122 science doctorates, 103 civil engineers, 529 mechanical engineers, and 786 electrical engineers.
- It should be noted that this question was very difficult to answer with a high degree of accuracy. We must caution readers to avoid making too precise judgements on the basis of these figures alone as they represent only broad estimates.

- According to Statistics Canada, the manufacturing industry in B.C. employed 69,848 people for 1987. Based on the response of surveyed manufacturers, we estimate an additional 26,392 new jobs will be created between 1990 and 1995. Specifically, we estimate about 80,000 total jobs for 1990, and by 1995, 106,000 industry jobs are predicted.
- The overwhelming demand for personnel skilled in the trades by manufacturers suggests that a stronger emphasis should be placed on increasing the number of students graduating from trade institutions such as B.C.I.T.

Chart 8.11



8.12 Projected Personnel Growth over the next 5 years

- Personnel demand data reveal that the computer software industry expects to experience the greatest growth of over 25% annually over the next 5 years. Much of this demand is for computer programmers, management personnel, marketing personnel, and people skilled in expert systems and CADD. Other subsectors like the electronics industry predict a 13% personnel growth rate. The remaining subsectors expect a personnel growth rate of less than 8% annually over the next 5 years.

Chart 8.13

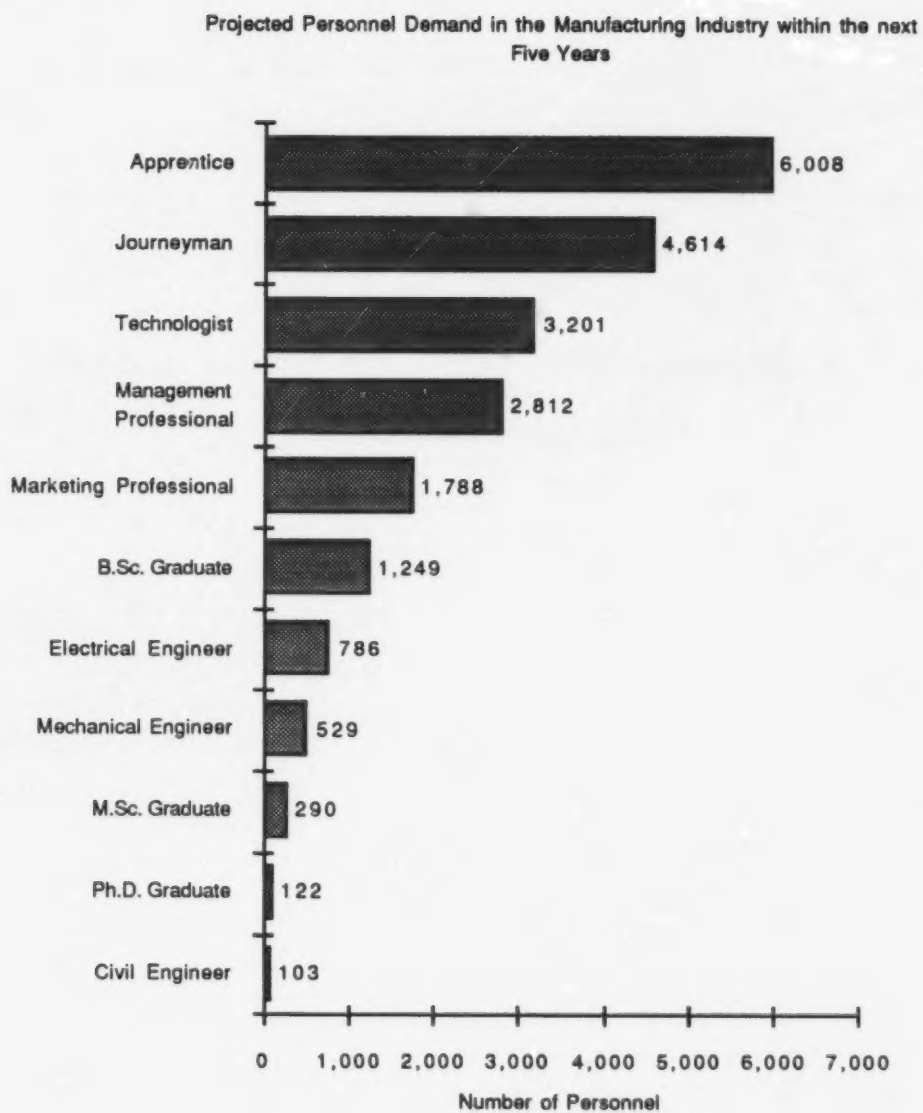
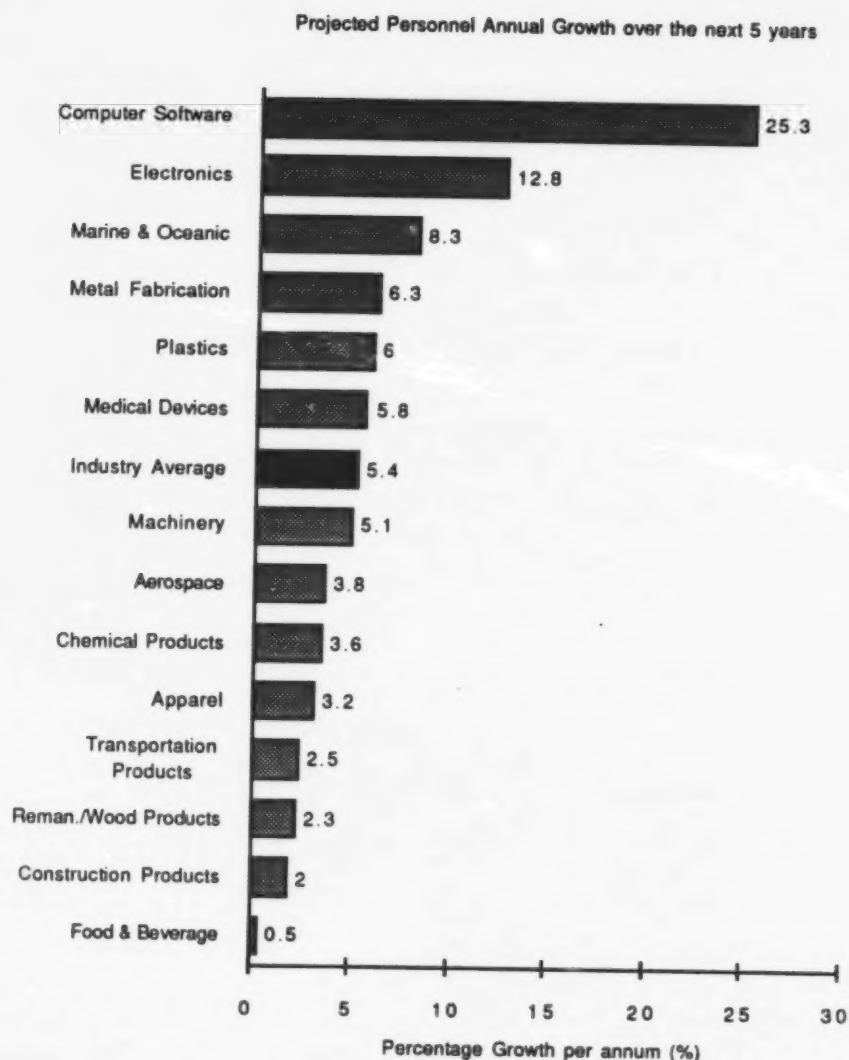
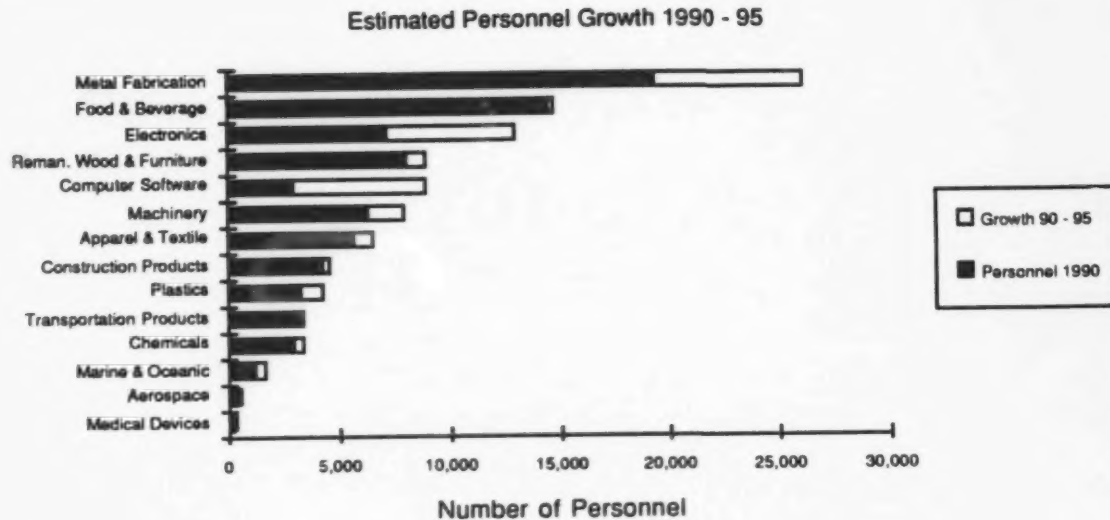


Chart 8.14



- High personnel growth rates are predicted for the metal fabrication, electronics, and computer software industries. As survey respondents indicated large demands for machinists and computer-skilled personnel, we expect this trend to continue. Infant industries such as the medical devices, aerospace, and marine & oceanic subsectors had the lowest predicted personnel growth volumes.

Chart 8.15



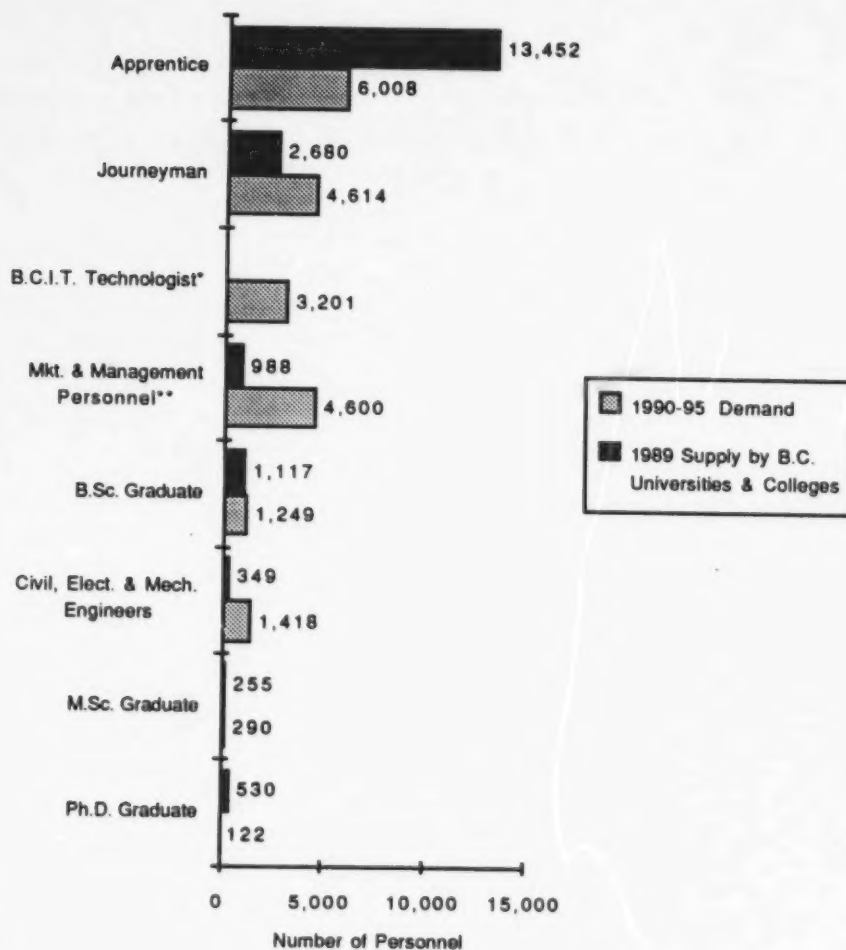
Source: Statistics Canada, Manufacturing Industries of Canada 1987, 31-203
B.C. Manufacturers' Needs Survey

8.16 Supply and Demand of Personnel

- Shortages exist for bachelor and masters of science graduates, marketing and management personnel, and civil, electrical, and mechanical engineers as reflected by Chart 8.14. The demand for journeymen is also high, but is offset by the large supply of apprentices. Demand for same pool of labour by other industries will shrink the size of this valuable resource and as a consequence, shortages of skilled labour for these particular skills are extreme. This result confirms that 72% of manufacturers surveyed in section 8.1 reported difficulties in finding skilled labour.

Chart 8.17

1989 Supply and Projected Annual Demand of Personnel by the B.C.
Manufacturing Industry



* 1989 supply information unavailable from BCIT.

** 1989 supply information unavailable from UVIC, BCIT, Camosun College, Malaspina College, N. Island College, Northern Lights College, & VCC.

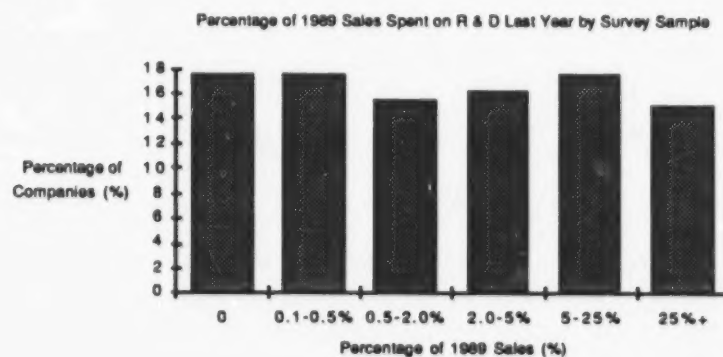
Source: Ministry of Advanced Education & Job Training.
Alumni Relations Office of UBC, SFU, Capilano College, Cariboo College, College of New Caledonia, Douglas College, Kwantlen College, Selkirk College, Opening Learning Agency, and Okanagan College.

9.0 Research and Development

9.1 Distribution of 1989 R & D Spending (Unweighted)

- According to Eli Konorti of Ernst & Young, world-class manufacturers spend three to four per cent of their gross annual sales on R & D*, while he estimates that B.C. companies generally spend about one half of a percent. (See Chart 9.4)
- One half of survey respondents report spending between 0.1-5.0% of sales on R & D. Another 18% of respondents spend between 5-25%, and finally, another 15% of respondents spend over 25% of their sales on R & D.
- If these figures hold true, 58% of survey respondents spend an extraordinarily amount of their sales on R & D, and should be at par with world-class manufacturers. Only a small percentage of start-up companies featured in the survey account for the high level of R & D spending. Since only 21.5% of manufacturers consider themselves leading-edge manufacturers, we suspect many respondents are either overly optimistic in reporting these figures or very modest in rating their level of production and technology.
- Approximately one out of every five manufacturers did not contribute any of their sales for R & D last year.

Chart 9.2

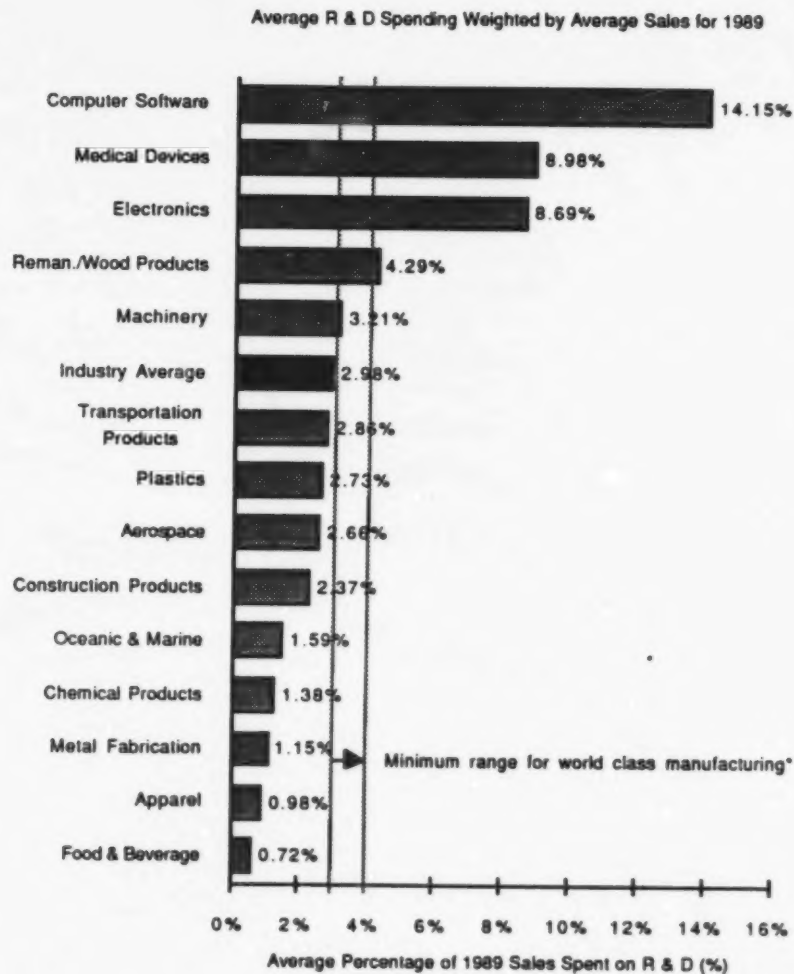


9.3 Average R & D Spending Weighted by Sales 1989

- When R & D spending was weighted by average sales, a different picture emerges. The three leading subsectors, computer software, medical devices, and electronics spend from 9-14% of their sales on R & D last year. The

remaining subsectors spent less than 4% of their sales on R & D. The apparel and food & beverage industries spent the least, with less than 1% of sales spent on R & D in 1989.

Chart 9.4

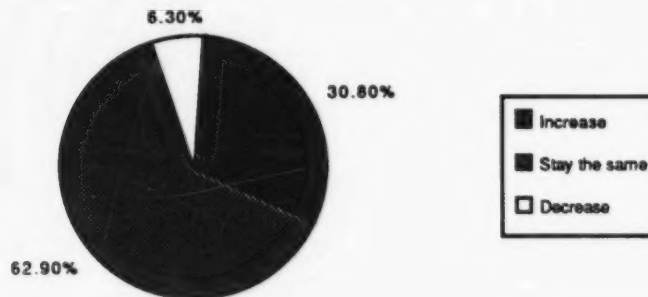


9.5 Planned R & D Spending

- Thirty-one percent of manufacturers plan to increase their R & D spending, 63% of manufacturers intend to spend the same amount as the previous year, and 6% of manufacturers plan to decrease their R & D spending for 1990.

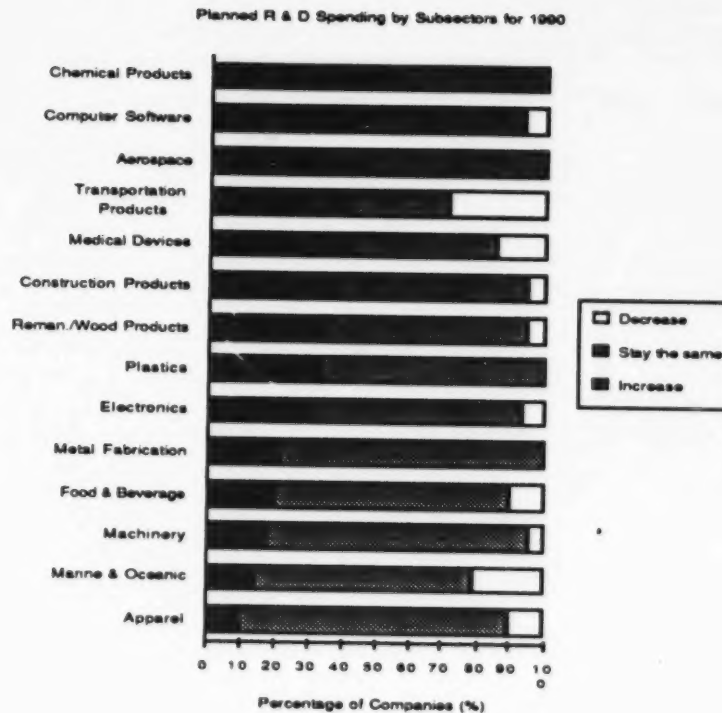
Chart 9.6

Planned Research & Development Spending for this Year



- Examining the same information by subsectors, we see that the chemical products, computer software, and aerospace industries have the largest percentage of companies planning to increase their R & D spending for this year.
- The machinery, marine & oceanic, and apparel industries plan to spend the least amount of their sales on R & D this year.

Chart 9.7



9.8 Allocation of R & D Work

- In general, one out of every three manufacturers do their R & D work in-house.
- Eight percent of manufacturers perform their R & D work exclusively at universities, 7% with another manufacturing company, 2% with a private company, and 13% with a non profit company.

9.9 R & D Spending Constraints

- The number one constraint facing manufacturers with regards to furthering more R & D work is the lack of money. Forty-seven percent of respondents report that poor sales and the lack of working capital prevent them from doing more R & D. Other major constraints include the lack of personnel and time.
- Seven percent of manufacturers say they are satisfied with the amount of

R & D work they perform, and another two percent of manufacturers feel that there is nothing holding them back from doing more R & D work.

Table 9.10

Please indicate what is preventing or restricting your company from doing more R & D.

TOP REASONS	RESPONDENTS	
	#	%
Money	143	47.2%
Lack of personnel	36	11.9%
Time	26	8.6%
No need	22	7.3%
Nothing	7	2.3%
Poor economy	7	2.3%
R & D done elsewhere	7	2.3%
Focus on marketing instead	6	2.0%
Lack of facilities	6	2.0%
Lack of government assistance	6	2.0%
No response	55	18.2%

9.11 Sources of Research and Development Assistance

- One out of three manufacturers go to suppliers, government agencies, or universities for product and manufacturing process research assistance.
- Ten percent of respondents look within the company for research assistance.
- In the case of product and manufacturing process development assistance, an almost identical picture appears, except more manufacturers employ consultants for help rather than universities, which were used by only three percent of manufacturers.

Table 9.12

4a. Where do you usually go for product and manufacturing process **research** assistance?

TOP RESPONSES	RESPONDENTS	
	#	%
Suppliers	37	12.2%
Government	33	11.0%
In house	32	10.6%
Universities	28	9.2%
Other manufacturers	20	6.6%
Consultants	18	5.9%
Trade publications	13	4.3%
Don't	11	3.6%
B.C. Research	9	3.0%
Europe	8	2.6%
Trade shows/seminars	7	2.3%
U.S.A.	6	2.0%
Forintek	4	1.3%
Library	3	1.0%

4b. Where do you usually go for product and manufacturing process **development** assistance?

TOP RESPONSES	RESPONDENTS	
	#	%
In house	44	14.5%
Government	29	9.6%
Suppliers	26	8.6%
Consultants	21	6.9%
Other manufacturers	14	4.6%
Don't	11	3.6%
Trade publications	10	3.3%
Universities	9	3.0%
Europe	8	2.6%
B.C. Research	7	2.3%
Nothing available	5	1.7%
U.S.A.	5	1.7%

9.13 Use of Government Organizations for Technical Advice

- About one out of every two manufacturers have used the services of a government organization for technical advice. Thirty-three percent of manufacturers went to provincial organizations such as SPARK and Western Economic Diversification for advice, and another 23% went to federal organizations such as IRAP for help last year.

- On average, each company paid two visits to a government organization, and 84% of them found their services helpful.
- The reasons why some manufacturers do not use government organizations for advice are longstanding and familiar. Many believe they could not be of any help, there is no need for their services, don't know where to go, are not aware they could help, and a desire to avoid red tape.

Table 9.14

In the last year, have you approached a federal or provincial organization (including universities and colleges) for technical advice?

ORGANIZATION	YES		NO	
	#	%	#	%
Federal	65	22.8%	171	56.4%
Provincial	102	33.8%	147	48.7%

If yes, approximately how many times did you seek advice over the last 12 months?

ORGANIZATION	NO. OF TIMES
Federal	142 (average: 2 visits/company)
Provincial	236 (average: 2 visits/company)

If yes, did this information help your company in any way?

RESPONDENTS		
	#	%
Yes	97	83.6%
No	19	16.4%

Table 9.15

In the last year, have you approached a federal or provincial organization (including universities and colleges) for technical advice? If no, please explain.

ORGANIZATION	RESPONDENTS WHO SAID "NO"	
	#	%
Federal	171	56.4%
Provincial	147	48.7%

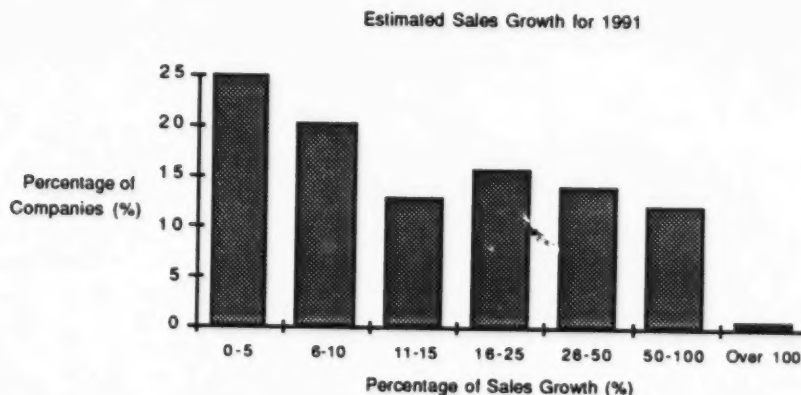
MAIN REASONS	NO. OF RESPONDENTS
Don't believe they can be of any help	22
No need	16
Don't know where to go	8
Nothing available	5
Desire to avoid red tape	6
Not aware they can help	4

10.0 Sales

10.1 Estimated Sales Growth

- Survey respondents seem to be optimistic about the future. Seventy-five percent of manufacturers anticipate sales growth of over 5 percent, and within this group, one out of every five manufacturers predict sales growth of over 25% for next year.

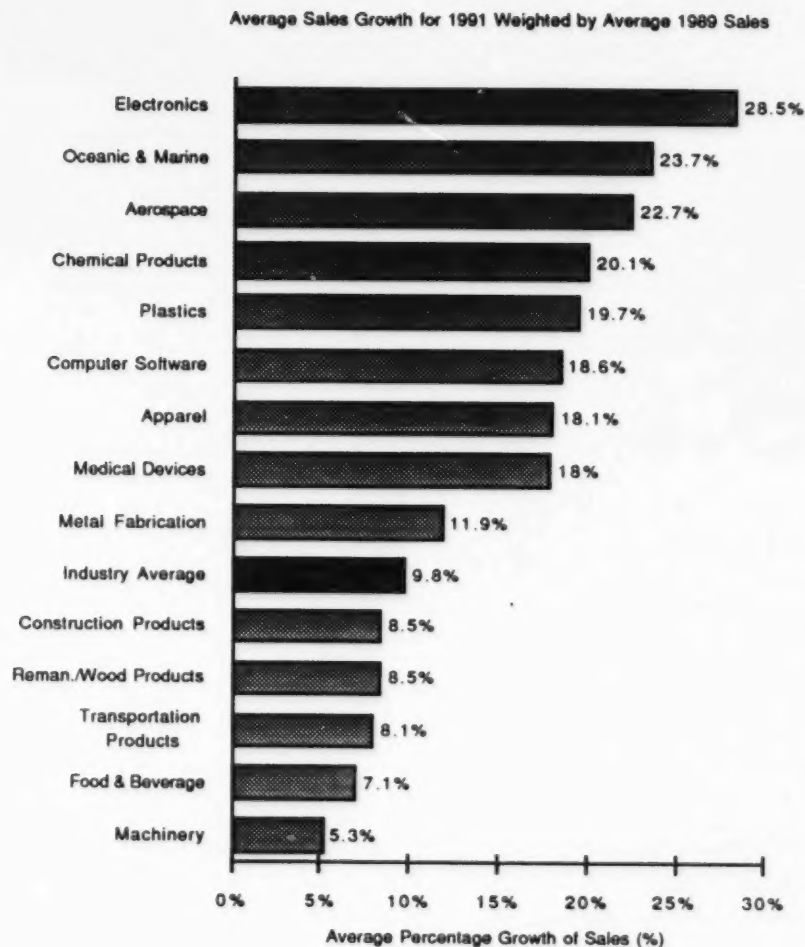
Chart 10.2



10.3 Average Sales Growth for 1991 Weighted by Average 1989 Sales

- The electronics industry anticipates the highest sales growth with an expected growth of 28.5%. Other leading industries include oceanic & marine with 23.7% expected growth, and aerospace with 22.7% expected growth.
- Subsectors which predicted the lowest sales growth rates include transportation products, food & beverage, and machinery with only single-digit gains.

Chart 10.4



10.5 Average Sales per Employee

10.6 Predicted Growth Versus Level of Technology

- Growth of sales seems to be somewhat related to the level of technology used in the company. A linear relationship with a correlation value of +.32 was described using the data collected from the survey. Near the tip of the line were electronics, oceanic & marine, and aerospace companies, and near

the base of the line were machinery, food & beverage, transportation products, construction, and remanufactured/wood products companies.

10.7 Predicted Growth Versus Level of Research & Development

- From our sample, growth of sales has no direct correlation with the amount of money spent on R & D.

10.8 What major reasons prevent your company from growing faster?

- One out two manufacturers cited the lack of capital as the primary cause of slow growth. The next leading cause was the shortage of trained people with 35% of manufacturers in agreement. Other reasons mentioned were poor market and too much competition.

Table 10.9

What are the major reasons that prevent your company from growing faster?

MAJOR REASONS	RESPONDENTS	
	#	%
Lack of working capital	158	52.1%
Shortage of trained people	106	35.0%
Lack of market planning & marketing	87	28.7%
Absence of start help	45	14.2%
Lack of technology transfer approaches	22	7.3%
Other:		
Poor market	8	2.6%
Competition	6	2.0%
Growing fast enough	4	1.3%

10.10 What opportunities do you foresee for your company in the next 5 years

- The Free Trade era will witness many B.C. manufacturers planning to increase their level of exports. Twenty-nine percent of manufacturers see the opening up of new markets as the biggest opportunity they intend to capitalize on. The U.S. market seems to be the prime destination of many of our made-in-B.C. products. Markets in South East Asia, Europe, Eastern Canada, South America, and other western provinces were listed as popular target markets.
- More than fifteen percent of manufacturers see opportunities in new products and technologies.

- On a positive note, three percent of manufacturers plan to go green with the introduction of environmentally safe products.

Table 10.11

What opportunities (new markets, products, technology, etc.) do you foresee for your company in the next 5 years?

TOP RESPONSES	RESPONDENTS	
	#	%
New markets (total)	88	29.0%
- U.S.A.	28	9.2%
- S.E. Asia	9	3.0%
- Europe	7	2.3%
- Eastern Canada	4	1.3%
- South America	4	1.3%
- Western Canada	3	1.0%
- Not specified	33	11.0%
New Products	35	11.6%
New Technology	13	4.3%
Introduction of automation in production	9	3.0%
Introduction of environmentally safe products	9	3.0%
Improved product, performance	6	2.0%
None	4	1.3%
Product diversification	3	1.0%
Exploration of aerospace industry	3	1.0%

11.1 Appendix

Glossary of Advanced Manufacturing Technology Terms Found in the Survey

Apprentice - One who is bound by a contractual arrangement between the Employer, the Provincial Government and him/herself for a specified period of time with a view to acquiring technical knowledge usually through attendance at technical training classes.

Automated Materials Handling (AMH) - Handling and moving of materials using automated devices.

Automation - A machine or control mechanism designed to follow automatically a predetermined sequence of operations or respond to encoded instructions.

Computer-Aided Design and Drafting (CADD) - Use of interactive graphic work stations for the preparation of drawings, replacing pen and paper drawing boards with computer terminals, light pens and other computer tools.

Computer-Aided Manufacturing (CAM) - All uses of computers directly in the manufacturing process.

Computer Controlled NC (Numerically Controlled) Machines (CNC) - Cut metal according to programmed instructions stored in a dedicated micro-processor and are delivered electronically.

Flexible Manufacturing System (FMS) - An arrangement of computer controlled machine tools which can automatically carry out a variety of machining operations on a range of components.

Journeyman - One who has completed an apprenticeship in a trade, craft or skill and/or is recognized by the Employer as an experienced, qualified and competent worker. He or she usually has 4 years or more of training.

Material Requirements Planning (MRP) - A process that uses bills of materials, inventory records, and the master schedule to determine when orders must be released to replenish inventories of parts or raw materials.

Manufacturing Resources Planning (MRP II) - An extension of MRP that converts all resource requirements into dollar terms to tie in other parts of the company.

Programmable Controllers - Small, dedicated computers used to control or monitor a variety of production processes (other than metal machining).

Quality Assurance (QA) - A planned and systematic pattern of all means and actions designed to provide adequate confidence that items or services meet contractual and jurisdictional requirements and will perform satisfactorily in service. Quality assurance includes quality control.

Quality Control (QC) - A form of inspection involving sampling of parts in a mathematical manner to determine whether or not the entire production run is acceptable, a specified number of defective parts being permissible.

Robotics - Reprogrammable, multi-functional, manipulators, designed to move workpieces or tools among various paths.

Technologist - An individual with 2 years or more of training and who has a diploma or certificate.



B.C. Manufacturers' Needs Survey

This survey will cover the following issues: manufacturing technology training and research centre, education and training, research and development, and company growth. This is your chance to give us your views on these very important issues. Your input is important to us and your participation is much appreciated. As a rule, all information is confidential. If you do not wish to answer a particular question, please feel free to leave it blank. We would much rather have the survey partially completed than not receive it at all.

Company Growth

Is the use of advanced technology related to company growth? In order to answer this question, we need to know what factors affect your company's performance.

1. Please estimate the percentage growth of sales next year.
 - ☐ 0 - 5%
 - ☐ 6 - 10%
 - ☐ 11 - 15%
 - ☐ 16 - 25%
 - ☐ 26 - 50%
 - ☐ 50 - 100%
2. Please rate the level of production and related technology of your company.
 - ☐ Leading edge technology
(International leadership in technology)
 - ☐ Advanced technology at par with competitors
 - ☐ Traditional technology
3. What advanced technologies are used in the company's production process?

4. Please check which technologies your company currently uses or will use by 1992.

Currently using	Anticipated usage by 1992	
☐	☐	Computer Assisted Design/Drafting (CADD)
☐	☐	Computer Assisted Manufacturing (CAM)
☐	☐	Computer numerically controlled machines (CNC)
☐	☐	Flexible manufacturing systems (FMS)
☐	☐	Automated materials handling
☐	☐	Programmable controllers
☐	☐	Materials requirements planning (MRP)
☐	☐	Manufacturing resources planning (MRP II)
☐	☐	Robotics and automation
☐	☐	Quality assurance and control program (QA)

5. What are the major reasons that prevent your company from growing faster.

____ Absence of start-up help
____ Lack of market planning & marketing
____ Lack of technology transfer approaches
____ Lack of working capital
____ Shortage of trained people
____ Other - please specify:

6. What opportunities (new markets, products, technology, etc.) do you foresee for your company in the next 5 years?

Manufacturing Technology Training and Research Centre

A proposal for the establishment of a joint industry/SFU/BCIT Manufacturing Technology Training and Research Centre is being considered. The centre will provide the following services:

1. *An outreach program eg. mobile lab and technology awareness seminars*
2. *Training, familiarization and development services*
3. *Demonstration of new technology*
4. *Technical consulting*
5. *Applied R & D*
6. *Information services*

The potential users of such centre will be B.C. manufacturers, such as yourself. Whether this project will go forward or not, will largely be up to you to decide. Please give us your views on the proposed centre by answering the following questions.

1. If a manufacturing technology training and research centre were established in B.C...

- a. Do you think you would use such a centre?

☐ Yes ☐ No

Please explain your answer: _____

- b. What facilities and services would you like to see offered?

- c. Please specify what percentage share of funding should be undertaken by industry and government.

_____ % Industry
_____ % Government

Education and Training

Having skilled people is vital to growing businesses. Help us plan our future training and education needs by answering these questions.

1. How important is it to you to find out information on advanced manufacturing technology?

☐ Not important

☐ Somewhat important

☐ Very important

2. Where do you seek information on advanced manufacturing technology?

☐ Do not seek information

☐ Information workshops

☐ Machinery supplier/vendor

☐ Government agencies

☐ Other manufacturers

☐ Trade publications

☐ Trade show

☐ Universities/colleges

☐ Outside B.C. - please specify where
and what type of information:

☐ Other - please specify:

3. If you do seek information on advanced manufacturing technology, what specific information are you seeking?

- 4a. Where do you usually go for training assistance?

- b. Does it adequately meet your training needs?

☐ Yes ☐ No

- 5a. What specific training skills does your company need?

- b. Are there any difficulties in finding people with these skills?

☐ Yes ☐ No

6. Which of the following constraints most affected your skills-training decision last year?

☐ There are no constraints - can hire all the trained workers needed

☐ Cannot afford to release workers during working hours

☐ Current level of training available was inadequate

☐ Don't have the facilities to provide formal training

- ☐ Don't have the personnel to provide formal training
- ☐ Don't have the time to train employees myself
- ☐ High cost of formal training
- ☐ Risk of losing trained employees to other companies too great
- ☐ Too few skilled jobs to justify formal training
- ☐ Training programs unavailable
- ☐ Other-please specify _____

7. Please estimate the number of skilled people your firm intends to hire over the next decade. If estimate is 0, please leave space blank.

	1990-92	1992-1995
Trades:		
- apprentice	_____	_____
- journeyman	_____	_____
B.C.I.T. technologist	_____	_____
University graduate:		
- B.Sc.	_____	_____
- M.Sc.	_____	_____
- Ph.D.	_____	_____
- P.Eng. Civil	_____	_____
- P.Eng. Electrical	_____	_____
- P.Eng. Mechanical	_____	_____
Other:		
- Marketing professional	_____	_____
- Management	_____	_____

Research and Development (in manufacturing process and product development)

Some companies say they cannot afford to do R & D, while other companies say they cannot afford not to do R & D. Tell us where you stand on this issue.

1. Please estimate the percentage of sales spent on R & D last year.

☐ 0%	☐ 5-10%
☐ 0.1-0.5%	☐ 10-25%
☐ 0.5-2.0%	☐ 25-50%
☐ 2.0-5%	☐ 50%+
2. This year, my R & D spending will..

increase by	_____%
stay the same as last year	_____%
decrease by	_____%
3. Please indicate what is preventing or restricting your company from doing more R & D.
4. Where do you usually go for...
 - a. product and manufacturing process research assistance? _____

b. product and manufacturing process development assistance? _____

5. Would you support the establishment of a technical hotline for manufacturers to get in touch with B.C. universities for advice?

☐ Yes ☐ No

Please explain: _____

7a. In the last year, have you approached a federal or provincial organization (including universities and colleges) for technical advice? (If no to both provincial and federal organizations, please go to question 7c.)

Federal

Provincial

☐ Yes ☐ No

☐ Yes ☐ No

If yes, approximately how many times
did you seek advice over the last
12 months? _____

If yes, approximately how many times
did you seek advice over the last
12 months? _____

b. If yes, did this information help your company in any way?

☐ Yes ☐ No

Please explain your answer: _____

c. If no, please explain.

8. Please indicate what percentage of your R & D work last year was performed...

in-house	_____ %
with an university or college	_____ %
with another manufacturing company	_____ %
with a private contractor	_____ %
with a non-profit research institute	_____ %
none	_____ %
other - please specify: _____	_____ %